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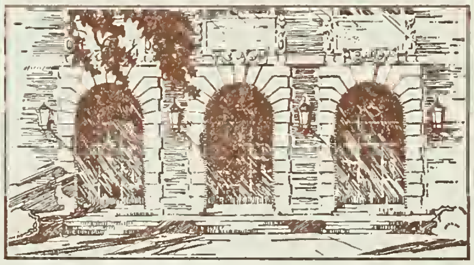

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AN ANALYSIS OF INTERREGIONAL MIGRATION FOR MANPOWER PLANNING

by

Morris M. Kleiner

August 31, 1974

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by

Morris M. Kleiner

Center for Advanced Computation
University of Illinois at Urbana-Champaign
Urbana, Illinois 61801

August 31, 1974

This work was supported in part by a grant from the U. S. Department of Labor (Grant No. 91-17-74-13 from the Manpower Administration under Title I of the Manpower Development Training Act of 1962), and was submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Economics in the Graduate College of the University of Illinois at Urbana-Champaign, October 1974.

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AN ANALYSIS OF INTERSTATE LABOR FORCE MIGRATION FOR MANPOWER PLANNING

Morris Michael Kleiner, Ph.D.
Department of Economics
University of Illinois at Urbana-Champaign, 1974

This study has two primary objectives: first, to implement a method for forecasting in and outmigration by age and color for states, and second, to develop an analysis of in and outmigration by occupation and age for states. Past and future labor force migration have important implications for state and regional economies and for their labor supply, which need to be identified and evaluated. This requires the integration of migration forecasts and analysis within a broader socio-economic system.

The major currents of migration in this century are discussed in the context of major historical and economic events. The long run effects of economic opportunity on migration are presented, as well as the importance of informal channels of information for inducing further migration. The understanding of long run migration trends are of considerable importance in further developing forecasting methods.

The theoretical basis of an empirical analysis is developed. The economic rationale of the migration process for individuals as well as its regional growth properties are stated. A regional labor market model is presented both verbally and mathematically, and a solution for migration is obtained. The reasons for greater disaggregation of the model are stated so that it can be of greater use in analyzing regional labor markets and for use in manpower planning.

The forecasting model that is implemented should be plausible and its performance evaluated with respect to other methods. In order to operationalize this, two econometric models are specified--one for inmigration by age and race, and the second one for outmigration by age and race. Statistical considerations preclude the maximization of both explanation and prediction concurrently. Given a priority to predictive performance, multicollinearity necessitates modest evaluations of the hypothesized relationships via the regression coefficients and their signs. Nevertheless, the results add considerable support to the validity of a socio-economic model to the explanation and prediction of migration, and to the underlying theoretical construction based on regional labor market theory.

Verification and accuracy tests are performed on the model, and the results show that a socio-economic approach was better able to detect changes in each flow and does better at avoiding extreme errors than a past-rates method. Matrix methods are used to implement iterative forecasts of migration for Illinois (1970-85 at five-year intervals) using three alternative economic forecasts. The policy implications of these forecasts for a variety of state services are discussed.

The study of factors that influence geographic occupational flows in the United States has received some theoretical attention but almost no empirical testing. Separate multiple regressions on in and out-migration by occupation and age are specified and estimated. In addition, the employment elasticities of specified industries are enumerated for each occupation. The migrant stock variable is the most statistically significant one, and the importance of the factors that

influence migration flows change for the various occupations and age groups. This can serve as useful information to state planners who are interested in attracting or retaining persons of various occupations.

The current institutional setting of interstate migration is stated as well as migration policies in other countries. Despite many areas of further research, this study clearly establishes the potential of socio-economic factors in analyzing and forecasting regional migration flows.

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CHAPTER I

INTRODUCTION

Focus of the Study

Economists have often asserted that the labor market allocates workers where they belong in terms of their productive ability. Comparative economic opportunity, they argue, is the driving force which is manifested in interregional labor force migration patterns. According to this hypothesis, relative employment, occupation, and salary are major considerations in any decision to move. In short, internal migration is an important way by which people respond to changing economic opportunities.

The analysis of interregional labor force migration for manpower planning is concerned with the optimum utilization of the present and potential human resources available in a region. The predominant orientation of manpower planning is with the future, though a thorough analysis must include present trends to provide guidelines for present policy. Thus with the labor market as the focus, an analysis of interstate migration and the implementation of functional migration forecasts will be developed for manpower planning purposes.

An Overview of the Project

There is general agreement that methodological difficulties exist in manpower forecasting. The main problems stem from the inability to forecast technical change, capital-labor substitution, productivity change, movements to and away from equilibrium, and their effects on job and occupation structures. Other areas of concern are the occupation-education relationship, the degree of substitution between qualifications; reconciliation between desired disaggregation on the one hand and estimate reliability on the other, and the integration of manpower analysis into broader-guaged economic analysis (Redwood, 1972).

Extensive efforts to improve the quality of manpower forecasting are currently being undertaken at the Center for Advanced Computation at the University of Illinois, Urbana Campus. These research efforts are directed toward the development of a system of manpower forecasting which yields forecasts of special purpose manpower and occupational requirements, accounts for the interdependence in the economy, and is capable of analyzing the manpower effects of alternative final demand patterns. The project thus far has resulted in the construction and estimation of the parameters of a model capable of analyzing the manpower effects of alternative expenditure patterns. In addition, state forecasts of population, employment, and educational enrollment have been developed for Illinois to 1985 (Redwood, 1972; Babcock, 1972; Dauffenbach, 1973).

The analysis and forecasting of interregional migration has tended to stand in isolation from the rest of the economic system. In addition, manpower planners have tended to ignore migration, or to take whatever is available without question or relationship. The following section will deal specifically with the key question of why migration analysis and projections are needed for manpower planning purposes. In addition, it will show how this basic research on economic influences on migration can help the forecaster develop a labor force forecasting model which is consistent with the economic conditions which he has assumed.

Significance of the Research

One of the principal problems facing any state government planner is the future workforce and population of the state. While it is possible to make reasonable regional forecasts of demand for workers, the forecasting of employment by projection of population using fertility and morality data and assumed past rates of migration fails to take account of the dynamic changes in national and regional patterns of expenditure and derived demand for labor (Folk, 1971). Increased knowledge of the structure of labor force migration and geographic occupational mobility is of potentially great significance in improving the understanding of the labor market and in making improved forecasts for manpower planning.

It is generally agreed that migration of the labor force age population is the most likely to contribute to the reduction of regional unemployment, to the equalization of factor costs, to interregional differences in population growth, and to the necessity for greater planning in providing the many services which are sensitive to population size and characteristics. In an integrated economic and manpower-forecasting system, for example, population and migration projections are the foundation for supply estimates of labor force participation, employment, education enrollments, and occupational supply patterns, and these can be related in an interactive manner to demand estimates of industry and occupational employment.

It has long been recognized that relative labor market forces influence mobility. Two initial empirical studies, one by Blanco (Blanco, 1963) and the other by Lowry (Lowry, 1966) have applied regression techniques to a labor-market oriented analysis of the migration of labor force age population (persons aged 15 to 65). A common contribution of these studies is that they provide empirical evidence of the importance of changes in employment opportunities in explaining net migration.

A significant contribution of Lowry's study is his hypothesis that the determinants of outmigration are different from those of inmigration. Lowry notes that outmigration is a function of life-cycle considerations: young people are inclined to seek employment, education, and new residences away from home, while older persons are generally less mobile because of established friendships and investment in jobs and houses. He derived this hypothesis from the finding that regardless of conditions within areas, a constant proportion of persons in each cohort outmigrates. Therefore, it is the size of cohort population rather than "push" factors which determines the size of outmigration. However, the destination of outmigration is determined by changes in employment opportunities. Areas which have the greatest increases in employment opportunities are likely to "pull" the greatest number of inmigrants.

The existence of definite patterns of movement among states by various occupations has long been recognized by investigators of labor market functioning. In addition, the implications of occupational migration for educational planning has often been stated. Little evidence, however, has been brought to bear on the factors that influence this movement. Lack of knowledge of the significance of geographic occupational mobility as an adjustment mechanism to changing compositions of labor demand may result in an overestimation or underestimation by the manpower planner of occupational requirements.

Several economists have shown that an "economic opportunity" model of migration when used in forecasting has a better chance of identifying changes in migration patterns than does a past-ratio method (Lowry, 1966; Olsen, 1972). This encourages the development of such a model as a technique for manpower forecasting. A full strategy would include age and color forecasts which would act in a recursive manner to provide greater consistency and accuracy in forecasting.

Criteria for Model Formulation and Analysis

It is important that two considerations exercise the main influence on the nature of the project and serve to establish the criteria and dimensions. First, the migration forecasting model should provide maximum utilization and analysis, and in addition provide an interconnection between the forecasts and manpower planning. Secondly, the analysis of geographic occupational mobility and migration paths should provide maximum utility for policy matters.

The formulation of the analysis and specification of the forecasting model should recognize the following criteria:

(1) The analysis must be capable of being implemented, and the forecasting model must be practical in terms of readily available data.

(2) In formulating the forecasting model a potential user would require assurances at least on the following three counts: a) that the errors of estimate generated by this method are tolerably small, and without systematic bias; b) values for the independent variables, needed to implement the forecast, can be obtained by some reasonable procedure; and c) that the fitted parameters are applicable to the particular context of the forecast as to the context in which they were chosen.

(3) The analysis and forecasting model should allow for sufficient disaggregation for multipurpose utilization: a) disaggregation by five year age groups (at least for those cohorts that have shown the most mobility); b) disaggregation by age and color (to show discrimination in state labor markets); c) disaggregation by occupation (to examine the major factors that influence geographic occupational mobility).

(4) The model should be functional in terms of time and regional dimensions. With respect to time, five-year iterative forecasts are the best obtainable given the data base for migration in this country. Similarly, subnational projections of economic activity in the United States are available only by states and economic subregions (U.S. Department of Commerce, 1972). The geographic delineation of states is straightforward, and forecasts can be readily obtained. In contrast, the

Bureau of the Census' definition of economic subregion and the Bureau of Economic Analysis' definition are not currently the same, although striking similarities exist. As a result, no projections can be obtained for these regions.

(5) The forecasting model should be able to be upgraded without major overhaul. This should enable the substitution of updated or improved data sets (i.e., O.B.E.R. Series E projections) without significant modification or reformulation of the model. In addition, data refinement should be possible when, for example, a Counterbudget approach is implemented.

Policy, Forecasts, Model

A major concern of government is to avoid mismatches between manpower demands and supplies. This requires more regional labor market information, and the implementation of detailed short-term and medium-term projections of labor supply by age and color. At its best, forecasting is a critical ingredient in advance planning, encouraging the realistic appraisal of the likely costs and benefits of differing programs to facilitate a reasonable distribution of scarce resources.

Although there has been some attempt to distinguish between forecasting and projections, their use in the literature is generally interchangeable (Levitan, Mangum, Marshall, 1972). Both make assumptions about how the important variables are likely to behave in the future and are then applied to extend the past performance of relevant variables. Accuracy is largely a function of the realism of the assumptions and the identification of the relevant variables. In general, forecasts and projections are based on implicit and explicit assumptions concerning the nature and direction of future trends. Because anticipated expectations are rarely met, forecasts should be regarded as "most likely" approximations.

The purpose of this model is to provide a method for an assessment of factors that influence the inmigration and outmigration of labor force eligibles. The regression technique will reflect the significance and degree of relationship between socio-economic variables in the i^{th} time period and in and outmigration of labor force eligibles in the j^{th} cohort. With the implementation of such a model better knowledge and forecasts will result. This, in turn, should lead to better decisions and policies.

CHAPTER II

LONG RUN MIGRATION TRENDS

Introduction

There have been three major currents of migration in the United States during the first half of this century. First, there was the westward movement, with one major stream moving through the northern states while another pushed along the southern states, and these streams met in California. The second was the movement from South to North, involving large numbers of Negroes. The third consisted of the continuous movement from rural areas to cities and involved a large amount of relatively short distance migration (Taeuber and Taeuber, 1958).

During this period there have been several currents and cross-currents. For example, a migrant moving from South Carolina heading north was more likely to move along the Atlantic Coast, whereas those from the rural South were more likely to go to Chicago or Detroit. Except for federal policies aimed at settling the western lands, there has been no overall national program for population distribution or redistribution. However, considerable effort has been exerted by individual states to recruit or discourage inmigrants. This effort was primarily for the purpose of increasing population or discouraging low income population, and little control was exercised over the distribution of the new arrivals within the state (Taeuber and Taeuber, 1958).

With this basic laissez-faire policy by federal and state government, it seems likely that unconstrained socio-economic factors influenced migration. Therefore, the purpose of this chapter is twofold. First, an attempt will be made to relate the major historical events during this century and their influence on migration. Secondly, the effect of economic opportunity on migration during the period will be noted. This setting can serve as a useful backdrop for analyzing and forecasting current and future migration paths.

Major Migration Paths

From the beginning of settlement on the east coast, there was a movement to the west. One factor leading to the westward movement was the growth of population due to the excess of births over deaths, and the arrival of new immigrants. Evidence of this movement is shown that in 1910 there were eight states which had received fewer than 10 percent of their inhabitants through migration from other states, while in 1950 there were no states which had received fewer than 10 percent of their native population from other states (Taeuber and Taeuber, 1958).

The westward movement during the period can be illustrated through Table 2-1. It is noteworthy to observe that in 1900 the census reported that 4.5 million persons born east of the Mississippi had moved west, and that about one-half million persons had made the move in the other direction.

The second notable path of migration was between the North and South. By 1900, the number going to the South had increased more rapidly than the number going to the North; however by 1950 the Census reported increases in both numbers, with the total for southern-born persons living in the North at about 5 million and the number of northern-born persons living in the South at approximately 3 million (see Table 2-2).

Table 2-1

Native Population Born East and Living West of the Mississippi River, or Vice Versa: 1900 to 1950

Area	1900	1930	1950
Total native population with State of birth reported	65,402,767	108,065,719	138,072,605
Born east of the Mississippi River*	51,163,588	77,755,710	96,202,155
Living east of the Mississippi River	46,651,491	72,609,788	90,379,295
Living west of the Mississippi River	4,512,097	5,145,922	5,822,860
Percent of total born east of the Mississippi River	8.8	6.6	6.1
Born west of the Mississippi River*	14,239,179	30,310,009	41,870,450
Living west of the Mississippi River	13,720,636	28,661,177	39,171,635
Living east of the Mississippi River	518,543	1,648,832	2,698,815
Percent of total born west of the Mississippi River	3.6	5.4	6.4
Net gain of States west of the Mississippi River* (excess of persons born east and living west of the Mississippi River over persons born west and living east)	3,993,554	3,497,090	3,124,045

*Minnesota and Louisiana are counted west of the Mississippi River.

Source: 1950 Census of Population, Vol. IV. Special Reports, Part 4, Chapter A, State of Birth, table 2.

Table 2-2

Native Population Born in the North and Living in the South or Vice Versa, 1900-1950

Area	1900	1930	1950
Total native population reporting birth and residence in North or South	62,098,675	97,746,825	119,617,550
Born in the North	37,941,559	59,468,321	72,085,765
Living in the North	36,920,109	57,590,129	68,984,475
Living in the South	1,021,450	1,878,192	3,101,290
Percent of total born in the North	2.7	3.2	4.3
Born in the South	24,157,116	38,278,504	47,531,785
Living in the South	22,861,263	34,981,175	42,522,110
Living in the North	1,295,853	3,297,329	5,009,675
Percent of total born in the South	5.4	8.6	10.5
Net gain of the North (excess of persons born in the South and living in the North over persons born in the North and living in the South)	274,403	1,419,137	1,908,385

Source: *1950 Census of Population*, Vol. IV, *Special Reports*, Part 4, Chapter A, State of Birth, table 3.

Estimates of total migration from rural to urban areas are available only for more recent years. Nearly half the net migration from rural to urban areas represented young persons who reached their twentieth birthday during the decade. The accelerated migration from rural areas during most of the time since 1940 involved no loss of agricultural output. Instead there was growth in agricultural productivity.

A major element of migration during the period was Negroes from the South to other parts of the country. As Table 2-3 shows, movement of Negroes from the southern states increased during the first three decades of the century, then slowed down during the 1930's and increased to the highest recorded level during the 1940's, 1950's, and early 1960's.

Historical Events and Migration

Several major events during the twentieth century have contributed to the aforementioned migration paths. First, the spread and concentration of technological change and industrial growth in central and western regions helped cause the migration of human resources to these areas. Second, the movement to the cities during and following World War I caused considerable shifts in manufacturing labor force. In the thirties, with the beginning of the Great Depression, there appeared a reverse movement to rural areas. However, the Second World War and the subsequent return to prosperity resulted in migration following the original paths.

By the early twentieth century, all the contiguous states had been brought into the national economy, and more growth no longer

Table 2-3

Estimated Net Migration of Negroes to Northern and Western Areas: 1900 to 1950*

Region and State	1900 to 1910	1910 to 1920	1920 to 1930	1930 to 1940	1940 to 1950
REGIONS					
Northeast	94,851	182,547	349,664	170,937	411,766
North Central	55,809	244,231	364,874	127,716	528,675
West	19,825	28,486	36,288	49,088	304,351
SELECTED STATES					
New York	35,944	63,243	173,219	135,890	243,627
New Jersey	18,140	24,486	67,251	9,512	53,555
Pennsylvania	33,006	82,651	101,913	20,319	89,624
Ohio	15,652	69,434	90,947	20,720	106,682
Illinois	23,710	69,720	119,530	49,394	179,751
Michigan	1,910	38,782	86,306	27,989	163,289
District of Columbia	10,180	18,432	16,352	47,497	61,167
California	9,817	16,179	36,666	41,228	258,935

*Based on Everett S. Lee *et al.*, Population Redistribution and Economic Growth, United States, 1870-1950, Vol. I, American Philosophical Society, Philadelphia, 1957.

involved the settlement and development of unexplored areas. The completion of the Panama Canal and the introduction of railroads reduced transport costs that had retarded the fuller development of the West. The resource potential of every region was at the disposal of a nation-wide system of production and marketing. The gradual decline of regional interest rates and wage differentials reflected the greater effective mobility of capital and labor.

With the growth of auto manufacturing during the early part of the twentieth century and high personal income per capita, there was a substantial net inmigration of labor to the north central states. In addition, the high personal income in the western states caused much migration to that area. But even here we should not forget the influence of war, such as the effect of the two World Wars in creating an exceptional labor demand and consequently breaking down some of the social barriers to nonwhite mobility (Easterlin, 1961). The outflow of blacks from the South exhibited a time-pattern which was the opposite of the inflow of Europeans and the internal migration of native whites (Thomas, 1972). That is, Negroes were substitutes for foreign immigrants in the northern states.

Immigration of whites to the United States had been running at an average of over a million a year between 1910 and 1914, was practically stopped by World War I, and there was a dramatic rise in the movement of blacks into the northern states. The shortage of labor in the industrializing North was so severe that recruiting agents were sent south to recruit blacks. When the war ended, immigration to this country was resumed on a large scale, but was abruptly ended by the passage of the Immigration Restriction Act of 1924. The number of blacks in the North was 44 percent in 1910-20 and 67 percent in 1920-30 (Thomas, 1972). The favorite states were New York, New Jersey, Pennsylvania, Ohio, Indiana, Illinois, Michigan, Wisconsin and the District of Columbia. Most of these northern states were losing white and gaining black population.

The blacks that moved north and west during this period came from primarily rural areas. Chronologically, the wave of black inmigrants to the North and West after World Wars I and II is the sixth in a succession of inmigrant waves to these areas since the Irish-German one in 1845-54.

The Great Depression caused a backflow of migration. Carter Goodrich's study noted that during periods of relative prosperity--the 1920's--there was a tendency "to clear population away from the regions that were to show the most extraordinary relief loads" (Goodrich, 1932). However, it is of interest that during the depression of the 30's there was a rather dramatic shift that brought people back to rural and often depressed areas. Goodrich cites that "migration during the depression has been toward the worst land areas as measured by the agricultural income or the plane of living indices" (Goodrich, 1932).

Although the data for this period is sketchy, estimates by the Bureau of Agricultural Economics show that during the calendar years 1931 and 1932 there was a substantial net movement of population from cities to farms. Chicago, for example, in 1934 had 3.5 percent fewer people than in 1930. The loss during the same period for both Philadelphia and Pittsburgh was 3.2 percent (Goodrich, 1932).

Population increases in the farm communities during the depression resulted from two separate influences: (1) failure of the surplus farm population to move to the cities, and (2) actual migration from the cities to the countryside. No matter what the relative weight of these two factors, it seems clear that during the early 1930's, in contrast to the situation that prevailed during most of the 1920's, a large number of people moved from the cities to the countryside.

With increased demand for goods and services in the late 1930's and early 1940's as a result of the United States' participation in World War II, there was a return to urban and westward migration. Blacks in southern agriculture, especially cotton, began to be displaced by more efficient capital intensive processes. As a result there was a renewal of black migration to northern states and to a greater extent western cities. Just as before the Second World War, the areas of black inmigration were areas of white outmigration. With whites, the movement was to the West Coast and to Florida.

Between 1940 and 1950 the migration from farms increased greatly, while the annual migration to farms remained at about the same level as during the preceding decade. An average of 2.1 million persons moved away from farms and an average of 1.2 million moved to farms. The movement away from farms was greater in the first half of the decade than during the second half. During the initial years after World War II, there was a large movement to farms, which consisted primarily of the returning servicemen. However, in 1947, the movement away from farms was resumed in full force. During the 1940's net outmigration from farms was equal to nearly one-third of the farm population (Taeuber and Taeuber, 1958). This trend continued but at a reduced level throughout the 1950's and early 1960's.

Economic Opportunity and Migration over Time

In seeking to explain migration and economic opportunity over time, it is convenient to distinguish between static and dynamic processes. Differences in per capita income can be illustrated by considering the long-run tendencies that would prevail in a stationary economy, one in which product demands were unchanging, factor supplies fixed, and technology constant. In such an economy any initial differences among regions in per capita income would tend to be eliminated by movements of productive factors and goods. Labor would tend to move to higher-wage areas until wage levels were equalized. However, in the short run, the resource or product movements might be accompanied by charges that would temporarily widen income differences. Therefore, the opening of trade might adversely affect certain industries in a particular area, and outmigration might cause a decline in the proportion of workers to dependents in the population.

Personal income per capita shows a trend toward convergence in this century (see Table 2-4). In addition, it is important to note that the southern states experienced an increase in personal income per capita, but this is in part due to the heavy outmigration of both whites and blacks during the period.

It has often been said that the migration process tends to lower the skill levels of origin places and raise the levels in destination places. The choice of areas to which migrants go is determined by the

Table 2-4

Personal Income per Capita in Each Region as Percentage of United States Average, 1900-1970

Regions	1900*	1920*	1930*	1940*	1950*	1960**	1970***
United States	100	100	100	100	100	100	100
Northeast	137	132	138	124	115	115	114
New England	134	124	129	121	109	109	109
Middle Atlantic	139	134	140	124	116	116	114
North Central	103	100	101	103	106	103	100
East North Central	106	108	111	112	112	108	104
West North Central	97	87	82	84	94	93	94
South	51	62	55	65	73	81	89
South Atlantic	45	59	56	69	74	83	91
East South Central	49	52	48	55	62	67	75
West South Central	61	72	61	70	80	82	85
West	163	122	115	125	114	110	105
Mountain	139	100	83	92	96	94	90
Pacific	163	135	130	138	121	118	111

* Harris, p. 538.

** U.S. Bureau of Economic Analysis, Long Term Economic Growth, 1860-1970. Washington, D.C.: 1973, p. 232.

*** Bretzfelder, p. 20.

economic opportunities being offered in the different places--the greater the opportunity, the longer the migration. Migrants generally find jobs in the destination regions. Although for some there is a substantial time lag so that the expanded labor supply does not cause unemployment, there is a tendency for regions which are growing because of inmigration to continue growing.

Table 2-5 shows the relationship between the average value of relative per capita income and average decade rate of net inmigration, natural increase, and the total increase of males, by region. Those regions with greater than total United States personal income per capita had positive net inmigration. On the other hand, of the regions with less than U.S. average per capita income, 3 of 4 had negative net inmigration. Although much greater disaggregation is needed, results of Table 2-5 support the hypothesis that net inmigration moves in the same direction as economic opportunity--as measured by personal income per capita. Throughout the period, regional economic opportunity drew migrants.

Another factor that influenced migration was the paths of information between different regions. One method of such information was the previous migration of the cohort. Throughout the first half of the century, this was especially true for nonwhites. The migration of nonwhites during the early part of the period helped lead to the migration of that group during the 1940's, 1950's, and 1960's. Previous migration of the cohort led to informal networks of information, which eased the uncertainty of those friends or relatives who were considering migrating. This in turn led to migration decisions for this group based on economic factors, such as income, and opportunity.

Table 2-5*

Average Value of Relative Per Capita Income and Average Decade Rate of Net In-migration, Natural Increase, and Total Increase of Males, Ages 15-64, by Region, 1880-1950

Division	Personal income per capita, per cent of United States (1)	Males, ages 15-64 per cent per decade[a] Rate of net in-migration (2)	Rate of natural increase (3)	Rate of total increase (4)
Pacific	153	30	2	33
Middle Atlantic	134	7	9	16
New England	128	6	6	12
Mountain	119	15	9	24
East North Central	108	4	11	15
West North Central	90	-1	12	12
West South Central	66	4	19	22
South Atlantic	56	-4	21	17
East South Central	52	-7	19	12
Average:				
Highest four	134	15	7	21
Lowest four	66	-2	18	16

*Harris, p. 540.

[a] The base for the decade rates is the mid-decade population of males ages 15-64 in the region.

CHAPTER III

A THEORETICAL BASIS OF MIGRATION MODELING

Conceptual Definition of Migration

The purpose of this chapter is to review the theoretical work on migration and to present an extension of migration theory based on labor market analysis. In addition, justification of extensions of the theory in order to expand its utilization for planning purposes is presented in detail.

In the process of developing a socio-economic theory of migration, it is essential to make clear the alternative concepts of migration. The following illustration will attempt to explain the types of migration to be examined. The absolute movement of labor force eligibles from one state to another can be classified into five categories:

1) Total inmigration to a state;
2) Total outmigration from a state;
3) Net migration of a state, i.e., total inmigration minus total outmigration;
4) Gross migration from one specific state to another specific state;
5) Net migration between two specific states.

In Figure 3-1 if state A is taken as the focal point of discussion, total inmigration to state A is the flow that sums together the movement of people from state B and C into state A. Gross migration to region A is given by the flows m_{b-a} and m_{c-a}

where m_{b-a} is the migration of people from state B to A, and m_{c-a} is the migration of people from region C to A. As a result of this method of classification, the net migration of region A is the difference between the inflow and outflow of migrants for state A, or the sum of m_{b-a} and m_{c-a} minus the sum of m_{a-b} and m_{a-c} (Rabianski, 1970).

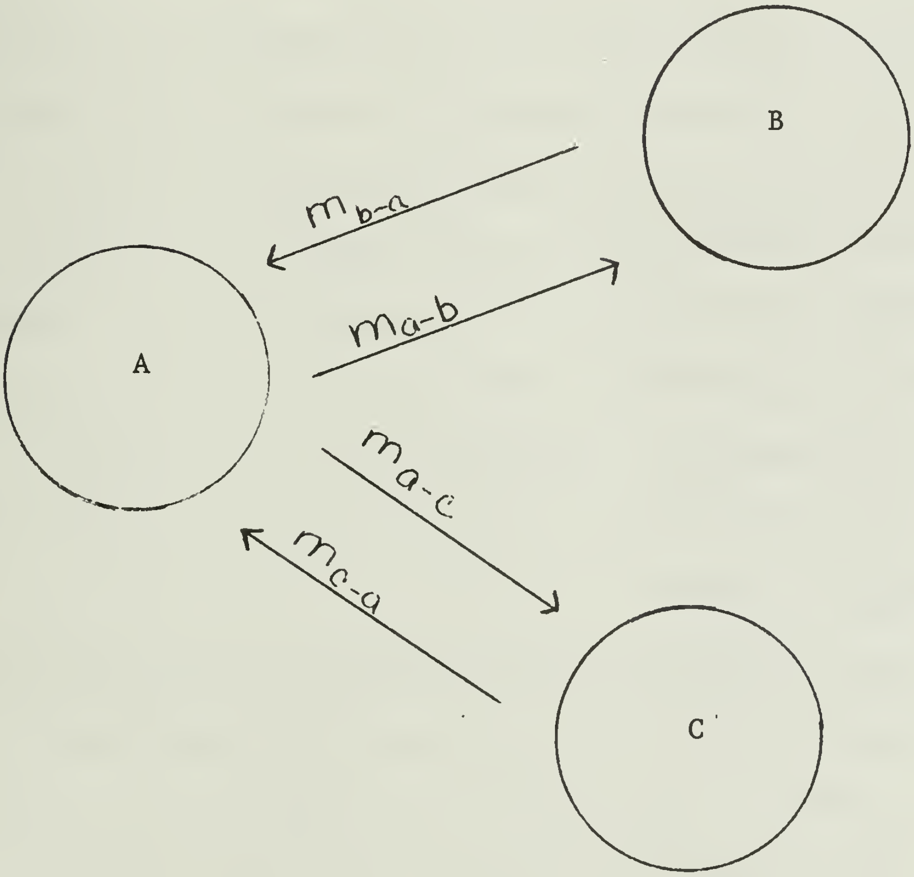


Figure 3-1

Rationale of Migration

To develop a socio-economic model of migration a reasonable answer should be formulated as to why people move. This model should include both economic factors (i.e., human capital theory) and social factors (desire to be with persons of the same age, color, and occupational cohort). In addition, the theory should be formulated in such a manner as to allow implementation within a probability framework.

Economists have often attempted to pose the question of labor migration as one of resource allocation. To accomplish this, migration is treated as an investment increasing the productivity of human resources. This investment has costs and renders a return over a specified period. The difficulty of this method is that it is necessary to identify and measure the costs as well as the returns to migration; its credit is the possibility of meaningful comparisons between migration and alternative methods of promoting better resource allocation (Sjaastad, 1962).

Private costs can be classified into money and non-money costs. The former include the out-of-pocket expenses of movement, while the latter include foregone earnings and the other costs of changing one's environment. For any particular individual, the money returns to migration will consist of a positive or negative increment to his real earnings stream to be obtained by moving to another place. It is obviously not adequate to simply compare labor earnings over space and assume that any observed differences arise from disequilibrium in the labor market. Other factors such as occupational composition would seem to explain a significant portion of earnings differentials among states. In addition, other demographic factors such as age and race affect earnings within an occupation.

In the above-mentioned context it is particularly useful to employ the human capital concept, and to view migration, training, and experience as investments in human capital. These investments in the individual are subject to depreciation and deterioration both in a physical and an economic sense. If market forces reduce the relative wages of a particular occupation, persons in that occupation suffer an income loss and are faced with the alternative of accepting lower earnings or lesser opportunities or making additional investments in themselves to increase their earnings in a more favorable market. If the relative wages or opportunity are adversely affected within a state, migration from that state is sufficient. If the adverse effect is national, as in agriculture which was discussed in the previous chapter, the entire occupational group is under stress and migration is feasible only if new skills are acquired by the migrant, and he moves to those areas in which his new skills are required. An additional phenomenon may be that people may move from locations with high median income into locations of low median income. They may actually improve their lot if they move from a lower portion of the distribution in their original location into a higher portion of the distribution in the new location (Schwartz, 1973).

Mathematically the internal rate of return to the migrant aged twenty can be obtained by solving the polynomial

$$\sum_{t=1}^{R} \frac{(E_t - U_t - C_t) P_t}{(1+p)^t} = 0$$

which is a polynomial in (1+p), for its largest real root, where E_t is the expected earnings of the migrant, U_t is the expected earnings of the person who does not migrate, C_t is the cost of migration all in time t, P_t = probability of survival through time t, and R is the time of retirement (end of 64th year of age) (Folk, 1970).

Although expected earnings of the migrant would appear to be a significant factor in explaining migration, the existence of opportunity for workers would also appear to be a major determinant of mobility. In The Theory of Wages J. R. Hicks noted this operation of the labor market:

> The principal hope (of employers) is to draw labour from outside the industry, or from another area, but then much of what can be hoped from this quarter may be secured simply by the prospect of assured employment... without a rise in wages. It may be only when this source dries up that firms will be forced to raise wages (Hicks, 1932, p. 68).

As in a competitive theory, workers respond to economic incentive, but changes in mobility are associated with changes in opportunity, while there is little change in the wage structure.

In addition to the economic factors, there are additional non-money costs and returns. The first non-money costs to consider are opportunity costs--that is the money earnings foregone, while searching for and learning a new job (Sjaastad, 1962). Another factor which would tend to be especially significant at latter stages of the life-cycle is the reluctance of some people to leave familiar surroundings, family, and friends.

Although these non-money costs involve no resource costs for the economy, they do affect resource allocation. It is highly probable that more migration would take place if psychic costs were zero for everyone. The optimal allocation of human resources must take tastes as given, and will differ from Pareto Optimality if certain persons prefer familiar over strange surroundings. Although we cannot treat noneconomic costs of migration as a component of the costs of migration, it poses a problem for an analysis of the rates of return. To the extent that some part of the existing earnings differential represents tastes alone, the rate of return to resources allocated to migration is biased.

Since noneconomic costs can be ignored in calculating rates of return, we should also expect that noneconomic returns from locational preferences represent consumption which has zero costs of production. As Sjaastad states,

> In a world of perfect competition and resource mobility no earnings differentials arising from these preferences would remain in final equilibrium; if discrimination were perfect, the existence of the preferences would be totally reflected in rents earned by factors specific to the climate. Moreover, the pure rents so paid should not be treated as costs of employment since they arise from tastes for location rather than differences in productivity (Sjaastad, 1962, p. 86).

Although not significant in influencing rates of return, private non-money returns to migration exist and influence behavior. Therefore, in the development of a labor market model of migration these influences should be examined in some detail.

Migration and Economic Growth

The application of "probability" to explain the decision to migrate from the rural to the urban sector was developed by Michael Todaro in a model of labor migration in underdeveloped countries (Todaro, 1969). In his model an economy is divided into the rural and the urban sectors rather than the agricultural and the industrial sectors. Next, the urban sector is divided into two subsectors; the urban modern sector and the urban traditional sector. Rural to urban migration is viewed as a two-stage process; first the movement to the urban area, and then the movement to the modern sector. A summary of the Todaro model would include the following relevant points:

1) The growth rate of the urban labor force is the sum of the growth rate of the natural increase of the urban labor force and the percentage of the net rural-urban migration during time t relative to the existing urban labor force.

2) The net rural-urban migration during any time t is governed by the wage differential between the discounted stream of the expected urban and rural real income (Hashimoto, 1973).

Although Todaro's model is not directly related to this study, his work provides insights into developing a migration model. In addition he develops a link between investment in human capital and growth theory.

A useful starting point for the development of a migration model is the neoclassical framework. A summation of this framework as it relates to migration is stated by Richardson as follows:

> Neoclassical general equilibrium theory predicts that in a situation characterized by interregional differentials in real wages, labour will migrate from the low-wage to the high-wage regions until real wages are

> equalized. This conclusion rests upon several critical assumptions: a comparative statics framework; homogeneous labor; constant returns to scale; zero migration costs; perfectly competitive labor markets; workers move in response to wage differentials and for no other reason (Richardson, 1969, p. 295).

It is obvious that these assumptions are heroic, and that an empirical model based on these assumptions would therefore have little application. Economists have therefore preferred models for testing which are modified versions of this neoclassical framework. The variations of this framework rely heavily on the phenomenon of labor market adjustment. Most retain the wage differential as a key determinant, drawing upon other labor-market variables to correct for the violation of perfect competition.

Within the view of neoclassical economic theory, migration is regarded as the spatial labor market adjustment mechanism. That is, labor is assumed to move to those regions whose output is growing the fastest. In addition, faster growing regions would be assumed to bid the price of labor up faster than slow growing regions, thereby attracting inmigrants. Labor is assumed to move from areas of lagging demand relative to supply to areas of excess demand relative to supply. Furthermore, it can be argued that outmigration from a region i is independently determined in that it is governed by characteristics within the region. However, the distribution of this given level of outmigration from region i between other regions in the system (1, 2, 3...j) may then be determined by relative growth rates (g_1-g_i, g_2-g_i, g_3-g_i, ...g_j-g_i) or relative income levels. The region with the highest growth rate will take the largest share of region i's migrants, and the region with the next highest growth rate the second highest share, and so on (Richardson, 1969). Thus, regional labor markets are moved toward equilibrium.

Since migration is assumed to be so closely tied to regional growth, it is important to analyze the factors influencing this process. Six essential characteristics of modern economic growth have been identified by Kuznets for nations, and the following four can be applied to the subnational level (Kuznets, 1973). First, there are high rates of growth of per capita product and of population in more highly developed regions. Second, the rate of increase in productivity is high, even when other factors besides labor are introduced. Third, he identifies the rate of change of structural transformation. This includes shifts from agricultural to nonagricultural pursuits (e.g., Todaro), and a change in the occupational composition of labor. Fourth, Kuznets identifies the structure of an area and its ideology as being an important factor in influencing growth.

Borts and Stein define economic growth as an increase in the total real value of income in a region (Borts and Stein, 1962). The increase in output will occur as a result of three changes: the increase in the supplies of capital and labor, technological change, and increases in economic efficiency. They state that declining regions share common economic characteristics, namely lower than average rates of growth of employment, of population, and of income. On the other hand, growing regions had higher than average rates of growth of employment, of population, and of income. In a dynamic sense, gains in output are available through resource shifts of this type.

In presenting and briefly accessing some of the more popular regional growth theories, the following have been selected. The "theories" to be examined are:

Neoclassical;

'Cumulative Causation' (Myrdal-Kaldor);

Econometric Models;

Multiregional Models.

Neoclassical models have tended to dominate regional growth theory. One major advantage of the neoclassical model over such models as Harrod-Domar is the relaxation of the assumption of fixed coefficients in production. In addition, in most Harrod-Domar type models labor is not specifically mentioned as being a parameter or a variable, though it is often implied (Brems, 1968). As a result its use in this study would be severely restricted.

A typical regional neoclassical model developed by Richardson is as follows:

$$\text{(a)} \quad y_i = a_i k_i + (1-a_i) l_i + t_i$$

$$\text{(b)} \quad k_i = \frac{s_i}{v_i} \pm \sum_j k_{ji}$$

$$\text{(c)} \quad l_i = n_i \pm \sum_j m_{ji}$$

$$\text{(d)} \quad k_{ji} = F(R_i - R_j)$$

$$\text{(e)} \quad m_{ji} = F(W_i - W_j)$$

where y = growth rate of output
k = growth rate of capital
l = growth rate of labor
t = growth rate of technical progress
a = capital's share in income

s = savings/income ratio
v = capital/output ratio
k_{ji} = annual flow of capital from region j to region i divided by the capital stock of the region
n = natural increase in population
m_{ji} = net flow of migrants from region j to i divided by the population
R = rate of return on capital
W = wage

Equations d and e relate the ability of the model to attract inputs from other regions and represent testable hypotheses; that capital and labor respond to differentials in factor returns (Richardson, 1973).

Among the first to propose a model of per capita income divergence was Myrdal's cumulative causation model (Myrdal, 1957). He stated that "the play of forces in the market normally tends to increase, rather than decrease the inequality between regions." He argued that the market forces lead to the grouping of increasing returns activity in certain areas of the economy; thus, regional growth was a disequilibrating process. More recently, Kaldor developed in a more rigorous manner Myrdal's hypothesis (Kaldor, 1970). Kaldor's model suggests that as trade is opened up between industrializing and rural regions in a free trade economy increasing returns favor the rich regions and slow the development in the poor; because of scale effects, the rich regions gain a virtual monopoly of industrial production. This version of the model yields potentially testable hypothesis such as a region's rate of productivity growth is an increasing function of its rate of growth.

Thus far little work has been attempted on econometric models of regional development. Some of the ones that have been attempted are L. R. Klein (1969), C. C. Harris (1970) and Olsen (1971). Although econometric models are not often developed within a theoretical discussion, the development of regional econometric models has been moulded by the availability of data rather than to test specific hypothesis. Richardson states that to the extent that the equations have yielded good fits and have been used for predictive purposes, the relationships that have been developed between the available data variables give the model an implicit theory. In addition, many regional econometric models have been developed as forecasting models. Therefore, if there is a large degree of structural stability in regional growth, and if the future path of regional development is noticeable in present conditions and past trends, then the distinction between a long-run forecasting model and a growth model becomes unclear (Richardson, 1973).

The final regional growth model to be discussed is the multiregional model. This topic also has not received much attention in regional growth literature. Typically, the analysis has included a shift-share model. The share analysis is concerned with the proportion of national industry totals (or other indicators of growth such as population and income) found within each region at a particular point in time. In contrast, shift analysis is concerned with regional changes in indicators of economic activity between two defined points of time. It consists of two components: the proportionality shift and the differential shift. The proportionality shift measures the industrial composition effect; whereas, the differential shifts relate that industries grow in some regions faster than others. Other methods often used are development planning models within an interregional context. This methodology is primarily concerned with working out regional sectoral distributions for achieving specified regional targets. Usually the model's framework is simplified to achieve a compromise between theoretical acceptability, the availability of data, and computational feasibility.

In briefly discussing these models it is apparent that each one has strengths and weaknesses. The neoclassical model is the most highly developed, and can be solved easily for a determinant solution. However, its unrealistic assumptions result in solutions which are too simplistic. The Myrdal-Kaldor cumulative causation model emphasizes the concept of increasing returns to scale, and the disequilibrating process of free trade for regions. It has thus far failed to present the model in such a manner to allow for its empirical testing. On the other hand, econometric models use the available data, but generally do not have solid theoretical foundations. The multiregional model develops the concept of relative supply and demand features in both static and dynamic dimensions. It suffers from mechanistic theoretical construction, and the data used is often crude and on scattered observations. In applying these theories to develop a labor market model of migration, an attempt will be made to synthesize the more theoretically acceptable portions of each and to recognize the importance of data limitations in implementation. In this manner the model can best be implemented for manpower planning purposes.

Toward a Socio-economic Theory of Migration

A simple conceptual model of migration can be developed using both definitional and structural equations and then solving to obtain a reduced-form model. It can then be estimated using econometric techniques. The assumptions of each of the equations and the theoretical and empirical justification of each will be presented. The model then will be developed mathematically, and a solution for migration in terms of the exogenous variables and parameters will be shown.

Within a given region the following labor market relationships are assumed to exist. First, given that the labor force participation rate (σ) is constant the change in employment over a specified period and the change in unemployment over the period is equal to the total change in labor supply over the period. The assumption of constant labor force participation, at least in the long run, is not as heroic as it may seem at first. In April 1947 the labor force participation rate for all males was 63.5, and in March 1972 it was 64.5. For females, the April 1947 participation rate was 51.2, while it was 54.9 in April 1972. The labor force participation rates did not change substantially over the twenty-five year period (Manpower Report of the President, 1973). Another definitional relationship is, given σ is constant, the net migration of those persons of labor force age during the period and the natural increase of those persons coming of labor force age minus deaths and retirement would equal the change in the supply of labor. Now, the change in demand for labor in the region over the period would be the same as the change in employment over the period.

The functional relationships in the region's labor market can also be identified and analyzed. The change in the supply of labor in a region can be thought as having a direct but lagged relationship to the wage differential of the area, and the other socio-economic factors that influence labor supply (e.g., government policy, climatic attractiveness of the area) behave in the same manner. It could be hypothesized that rational persons observe areas that are growing and appear to have opportunities, and then move to these areas (Redwood and Kleiner, 1974). In contrast, the unemployment rate is inversely related to labor supply in the current period. Several works have argued for the inclusion of unemployment and uncertainty within a labor supply relationship (Todaro, 1969; Hartley and Richardson, 1974). It seems plausible that as the unemployment rate increases, persons within a given region are forced to look elsewhere for employment.

The structural equation for the change in labor demand can be developed in the following manner. The change in employment for last year will be directly related, while the change in unemployment will be inversely related to the change in the demand for labor in the current year. Last year's business outlook is reflected in this year's investment decisions. In addition, increases or declines in investment are reflected in changes in labor, the derived demand. This year's data will most often be implemented in next year's decisions for businessmen (Jorgenson and Stephenson, 1967). Similarly, the lagged wage differential for the region will be inversely related to the change in the demand for labor in the region in the current period. Within this system migration would be related to the natural increase of labor force population, the change in employment in the previous period, the previous period's wage differential, the change in unemployment in the previous period and certain noneconomic factors.

The structural and reduced-form nature of the model can be developed succinctly in mathematical form:

Notation

ΔL_S - change in labor supply

ΔL_D - change in labor demand

ΔE - change in employment

ΔU - change in unemployment

N - noneconomic attractions

σ - labor force participation rate

M - net migration of labor force

Π - natural increase in labor force

WD - wage differential of area

Φ - parameter of WD

γ - parameter of WD

ε - parameter of U

θ - parameter of U

β - parameter of E

α - parameter of N

let i be the designated region

let t be the time coordinate dating variables

assume $\frac{\partial \sigma}{\partial t} = 0$

The structural equations are the following:

$$(3\text{-}1)\quad \Delta E^i_t + \Delta U^i_t \equiv \Delta L^i_{S_t}$$

$$(3\text{-}2)\quad M^i_t + \Pi^i_t \equiv \Delta L^i_{S_t}$$

$$(3\text{-}3)\quad \Delta L^i_{S_t} = \alpha N^i_{t-1} + \Phi\, WD^i_{t-1} - \varepsilon \Delta U^i_t$$

$$(3\text{-}4)\quad \Delta L^i_{D_t} = \beta \Delta E^i_{t-1} - \theta \Delta U^i_{t-1} - \gamma\, WD^i_{t-1}$$

$$(3\text{-}5)\quad \Delta L^i_{D_t} \equiv \Delta E^i_t$$

The endogenous variables of the model are ΔE^i_t, ΔU^i_t, $\Delta L^i_{S_t}$, $\Delta L^i_{D_t}$, M^i_t. The exogenous variables are E^i_{t-1}, N^i_{t-1}, Π^i_{t-1}, WD^i_{t-1}, and the parameters are Φ, γ, ε, β, α, and θ. Therefore, there are five independent equations with sufficient exogenous variables to make the system identifiable. Now solving the system of equations for migration in terms of parameters and exogenous variables (see Appendix A) equation (3-11) can be derived in the following form:

$$(3\text{-}11)\quad M^i_t = -\Pi^i_t + \left(\frac{\varepsilon\beta}{1+\varepsilon}\right) E^i_{t-1} + \left(\frac{-\gamma\varepsilon}{1+\varepsilon} + \Phi\right) WD^i_{t-1} - \left(\frac{\varepsilon\theta}{1+\varepsilon}\right) U^i_{t-1} + \left(\frac{\alpha}{1+\varepsilon}\right) N^i_{t-1} \;.$$

The solution specified by equation (3-11) is the reduced form of the model, and estimation procedures can be applied with some modifications. This model has several advantages over current migration analysis. First, the model is based on definitional and structural behavior within labor market theory. Second, this model is not under the confining assumptions of the neoclassical model, such as full employment. Finally, the reduced form allows for testing given the current data base available through the Bureau of the Census. In sum, this solution for migration seems to be an improvement over _apriori_ hypothesis of migration.

The Case for Directional Flows

As was developed earlier, there are alternative methods of ascertaining interregional migration. The magnitude of directional flows can be assessed as in and out separately or in net terms (in minus out). In and outmigration has been decided upon mainly because of its greater disaggregation, and therefore its potential utilization for manpower planning purposes. This section will elaborate upon the benefits to be gained by this disaggregation.

An individual cannot be classified as a "net migrant"; there are either inmigrants or outmigrants. If one considers directional flows rather than net migration at the regional level it is possible to identify different determinants as Lowry has hypothesized, and that Beale has tested (Lowry, 1966; Beale, 1969). Different factors may explain why more people are moving out of an area than are arriving, while there are still people moving into regions with negative income differentials or leaving areas with positive income differentials. Directional flows may therefore approximate more closely the individual or household decision-making, while net migration is a regional property which can be examined to determine whether more people are leaving than arriving (Klaassen and Drewe, 1973).

Both the volume of in and outmigration of those of labor force age is important to planners given their concern for the turnover of jobs, houses and community services. In addition, information about the composition of the directional flows is important, especially their age and skill characteristics. Regions with small net migration may be gainers or losers in qualitative terms. Positive or negative net migration can also be devalued or 'revalued' when the quality of in and outmigration is investigated in more detail. Furthermore when directional flows are available, it is not difficult to compute the more aggregate indicators such as net migration. Considerations like these underline the importance of placing interregional labor migration in the context of national and regional labor markets (Klaassen and Drewe, 1973).

Another reason for using directional flows is that net migration is usually small in comparison with in and outmigration. Net migration may therefore reflect measurement errors. In any sample census users are often warned about the presence of bias, under-enumeration and serious errors in the five-year migration data--apart from the normal sample error. Therefore, the analysis of net migration data may be concerned with statistical artifact.

Although directional flows provide a better insight into a region's development problems and a superior basis for prescribing remedies, net migration can function as a warning device. Regions often face a zero-sum problem (assuming that foreign in and outmigration are to be balanced) if one region gains migrants the others must lose. The reasons for preferring in and outmigration have been discussed, and net migration can therefore be regarded only as a second best solution.

The Level of Disaggregation

The body of theory and empirical evidence to date has shown that differences exist in age, color, and occupational migration patterns. This section will attempt to enumerate and briefly develop these distinctions. In particular, the disaggregation will focus on white, Negro, age, and occupational disaggregation. In sum, this detail will allow for a qualitative analysis of directional flows.

At present geographic mobility is lower among Negro than white families in the U.S. Negroes have had incentives which have no exact counterpart among most white families, such as the greater racial barriers which existed in the South, and the disappearance of employment opportunities in Southern agriculture. In contrast, Negroes have had characteristics which have also inhibited their geographic mobility. Their educational level is low compared to whites, and they are found in more blue collar and service occupations where small incomes are frequent. As a result, Negroes are less likely to have financial reserves than whites, and generally higher levels of unemployment have made lesser geographic mobility a matter of particular concern (Lansing and Mueller, 1967).

Other studies have indicated the variation in explaining the factors that influence white and Negro migration. Andrei Rogers has related that his regression statistics showed factors motivating nonwhite migration, of which at least 90% was Negro, are strikingly different from those influencing white movements. Whereas the Rogers' employment opportunity model accounts for 80% of the total variance in the case of white flows, it only explains 27% of the total variation in the case of nonwhite movements (Rogers, May 1967). Richard Raymond concurs, stating that "while economic factors were statistically significant they nevertheless played a relatively minor role in the overall direction of nonwhite migration. The bulk of nonwhite migrants moved in response to differences in the size of nonwhite populations among S.M.S.A.'s" (Raymond, January 1972). Finally, the Bureau of the Census has shown that the migration rate between counties and also between states was higher for whites than for Negroes. The rate between counties from March 1969 to March 1970 for whites was 7.0 percent and 4.4 percent for Negroes; whereas the migration between states for the same period was 3.8 percent for whites and 3.3 percent for Negroes (Current Population Reports, Series P-20, No. 210, 1971).

Some have suggested that educational and occupational differences between the Negro and the white population account fully for the observed differences in geographic mobility. Lansing and Mueller's study, shown on Table 3-1, suggests that the answer to this hypothesis is "no." They state that "when Negro and white adults with the same education or occupation are compared, the Negro groups still appear considerably less mobile than the corresponding white groups." Therefore, the evidence presented is of sufficient weight to attempt to disaggregate the analysis to take into account the differences in white and Negro mobility patterns and influences.

The relationship of age to migration has been alluded to earlier. The argument is essentially that if young people have an incentive to migrate in order to increase their future earnings, they will have an incentive to do so immediately. Becker has argued that

Table 3-1

Negro and White Mobility

Demographic Characteristics	Percentage in Each Group Who Have Moved in the Past 5 Years	
Education	White	Negro
8 grades or less	8	4
9-12 grades	15	11
College	30	10
Occupation	White	Negro
Professional, managerial	31	5
Laborers, service workers, operatives	16	6
Other	13	8

Source: John B. Lansing and Eva Mueller, The Geographic Mobility of Labor, 1967, p. 275.

if people receive general training from their formal education and specific training on their jobs, one would expect their mobility to be greatest before they have received much specific training (Becker, 1964). Another hypothesis of the effect of age on mobility is that age is a proxy for the stage in the family life cycle. This hypothesis states that the "cost" of moving depends on the number of people in the unit to be moved. Such considerations also would lead to a decline in mobility after people pass the early twenties (Lansing and Mueller, 1967).

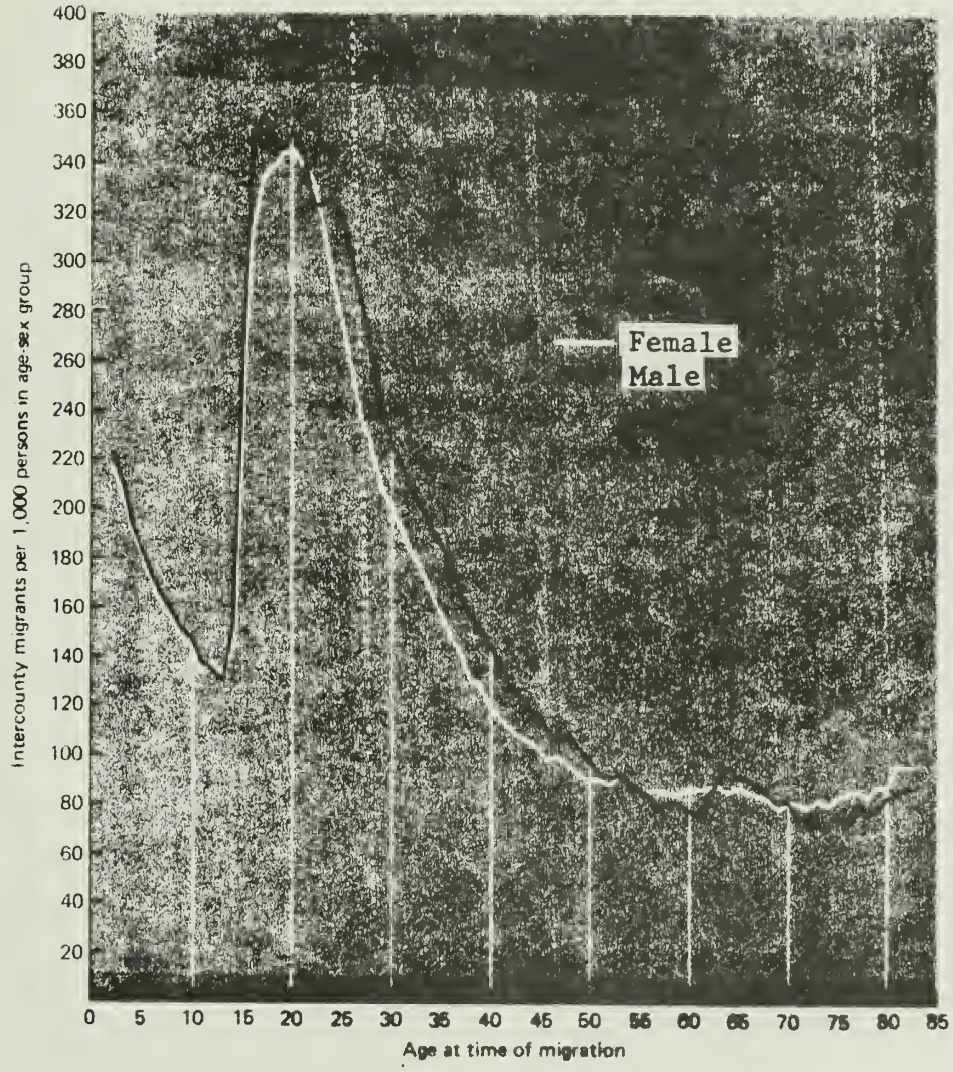
Typically, peak mobility occurs among persons in their early twenties--the age when children normally have left or are leaving their parental homes and finding suitable employment, and setting up households of their own. Most of these characteristic life-cycle variations can be seen in Table 3-2. Age is the most distinctly associated with migration-rate differentials. Most migration is done by young adults. In addition, from Table 3-2, there seems to be no significant difference in migration rates for males and females. In fact, they follow similar paths, and a separation of migration rates by sex would add little to the analysis.

The results of Table 3-2 suggest that disaggregation by at least 5 year cohorts for high migration age groups, and lesser aggregation for others, is essential. In this manner some qualitative conclusions can be drawn with respect to the demographic composition of the migration flows.

Any analysis which purports to be of use for planning purposes should recognize the importance of the occupational composition of the incoming and outgoing migrants. It would also seem apparent that there is considerable variation among occupations with respect to geographic mobility. In a modern economy mobility occurs in part because people with highly specialized knowledge and highly differentiated skills must be matched with job openings which call for specific types of knowledge and training. In order to maximize one's opportunities or income, a person may have to move across state lines to the most suitable job opening. This matching of occupations affects primarily people in professional, managerial, or skilled technical work.

Table 3-2

Male and Female Mobility



Source: Everett S. Lee and G. Putnam Barber, "Differentials in Spatial Mobility," in H. G. Beard, ed., National Vocational-Technical Education Seminar on Occupational Mobility and Migration, Center Seminar and Conference Report No. 2 (Raleigh, N.C.: North Carolina State University at Raleigh, Center for Occupational Education, 1966), p. 134; and E. G. Hoover, An Introduction to Regional Economics, 1970, p. 175.

Often migration for persons with special skills takes place within large firms which "transfer" personnel from one location to another, which is many times based on a region's economic growth.

Evidence of the characteristics of migrants is provided by Blau and Duncan in their study of the occupational status of American men aged 20-64. Their study concludes the following:

> ... the careers of migrants are in almost all comparisons, clearly superior to those of nonmigrants .... Whether migration between regions or between communities is examined; whether migration since birth or only after adolescence is considered; whether migrants are compared to nonmigrants within ethnic-nativity groupings or without employing these controls; whether education and first job are held constant; and whether migrants are compared to natives in their place of origin or their place of destination--migrants tend to attain higher occupation levels and to experience more upward mobility than nonmigrants (Blau and Duncan, 1967, pp. 271-272).

Additional evidence is provided by Table 3-3 which shows migration rates for men in three mature age groups according to occupational status. In general, high income or status occupations tend to be more mobile. Therefore, an analysis of occupational geographic mobility would enhance the usefulness of this study for state manpower planning purposes. Furthermore, a study which relates the economic and social environment of a state to the inflow and outflow of occupations would further our knowledge of labor market functioning.

In conclusion, this chapter has attempted to develop the theory of migration upon which the empirical analysis will be based. Practical extensions of the mathematical model were suggested in order to provide greater detail for state planning and for an improved understanding of

Table 3-3

U.S. Intercounty Migration Rates per 100 for Males,
by Age and Occupational Status, 1966-67

	Age		
	25-34	35-44	45-64
By Occupational Status:			
White Collar	12.8	6.6	3.2
Manual	9.1	4.9	2.3
Service	7.7	1.8	3.2
Farmers and Farm Managers	3.3	2.2	0.4

Source: U.S. Department of Commerce, Bureau of the Census, Current Population Reports: Population Characteristics, Series P-20, No. 171 (Washington, D.C.: Government Printing Office, April 30, 1968).

the labor market. The remaining chapters will show how this basic model can be applied to implement an interstate migration forecasting model and to analyze interstate occupational flows.

CHAPTER IV

THE DEVELOPMENT OF THE FORECASTING MODELS

Backdrop of a Forecasting Evaluation

The Employment Act of 1946 generated greater interest in the size of the labor force. By the early and mid 1960's, as a result of the development of new manpower programs, there was an increased demand for advance information about manpower changes. This chapter will review the "state of the art" and attempt to present an interstate migration forecasting model based on the theoretical foundations presented in Chapter III.

Questions are often raised concerning the usefulness of manpower forecasts. Levitan, Mangum, and Marshall suggest that forecasts:

> a) illuminate likely bottlenecks and imbalances in particular segments of the labor market, b) indicate the likely consequences of instituting changes in existing programs or introducing new programs, and c) provide an estimate of the total manpower resource "pie" by helping to 'price out' societal goals in manpower terms, to choose among these goals when necessary, and to move them along the least-cost path (Levitan, Mangum, and Marshall, 1972, p. 78).

The development of any migration forecasting model should be based on plausible assumptions concerning human behavior and economic growth. In addition, the final model tested and implemented should be believable, and have sufficient theoretical underpinnings. Finally, the model should be operationalized on past data, and its performance evaluated with respect to other methods. Forecasting models, which improve the "state of the art," though their errors are large, can serve as benchmarks for the building of more sophisticated and accurate methods of migration projections.

There exists some concern over the appropriate geographic area for the analysis of migration. This study has decided upon states for the following reasons. First, it is generally agreed that migration across state lines is a significant component of movement for political or administrative areas. Secondly, economic policy that influences migration can be planned best at the state level. Furthermore, a starting point for any policy which is intended to encourage (or discourage) migration can be implemented more easily at the state level. Finally, the existence of migration data and of the factors that have been theorized to influence migration are more easily obtainable for state boundaries.

Methods of Migration Forecasting

Numerous methods have been developed to forecast migration over the past twenty-five years. This section will attempt to briefly enumerate some of these methods, and evaluate them in light of the criteria stated in this thesis.

The simplest method of obtaining a forecast of migration is by extrapolation of past trends. The procedure is to determine migration totals or rates for some period in the past and fit a trend line to the past data. Although this method may be sufficient to determine births and deaths, which are considered relatively stable phenomena, it is inadequate to forecast migration. In contrast to fertility and mortality, the migration element of population change is much more volatile and marginal (Isard, 1960).

Various types of mathematical curves have been applied to past data, and these have been used to forecast migration. Two of the more common ones are the Gompertz and the logistic curves. The Gompertz curve is asymptotic at both ends, and in the initial periods of growth, the absolute increments are increasing in size, and in subsequent periods the absolute increments are decreasing. By establishing upper and lower limits to possible population, the curve overcomes the defect of forecasting impossible populations. The logistic curve is S-shaped and has the same general characteristics as the Gompertz curve. Its parameters are based on past data, and implies that determinants of past population will continue to act in the future (Isard, 1960). However, neither of these methods relates migration to the economic forces in an area or develop specific behavioral relationships.

Ratio methods represent an improvement over trend extrapolation. This method recognizes that migration is not an isolated phenomenon, and the forecasts are not wholly dependent on previous migration. In general, ratio methods assume that migration for a given area is a percentage of total population change of the area. A set of projections using this method has been implemented for the state of Illinois to the year 2010 (Altes, 1967). One long run weakness of this procedure is that inmigration states automatically receive larger numbers of inmigrants, while the remaining states are forced to provide unreasonable numbers of outmigrants, since the base population in the latter states becomes a smaller proportion of the national population as a result of outmigration.

A somewhat more sophisticated version of the past-rates method has been developed by the Bureau of the Census (Bureau of the Census, Number 477, 1972). Their methodology is as follows:

> Gross out migration, using rates estimated for the base period, was projected first. The out-migrants for all States were summed to form a national migrant pool. These migrants were then distributed back to the States as inmigrants, using proportions estimated for the base period. .... For example, a State growing rapidly from net in-migration contributes an increasing share of the migrant pool since its population grows more rapidly than the national average. The number of inmigrants, however, increases only at the national population growth rate since each State receives an unvarying proportion of the migrant pool (Current Population Reports, P-25, #477, p. 2).

This methodology, in spite of all its data manipulation, fails to relate migration to individual behavior or regional economic growth. Furthermore, no basis of comparison is provided in order to evaluate the method.

Among the first attempts to develop a theoretical model and apply regression techniques to an economic opportunity analysis was Lowry's analysis of net migration for S.M.S.A.'s (Lowry, 1966). Although there is little disaggregation, the results suggest that this methodology can do a better job of forecasting changes in migration patterns than does trend extrapolation and does at least as well in avoiding extreme errors. As was detailed in Chapter I, Lowry hypothesizes that the determinants of outmigration are different than the determinants of inmigration. However, recent empirical testing has shown that outmigration is sensitive to the economic conditions as well as the demographic composition of the origin (Renshaw, 1970; Miller, 1973).

Recent attempts to forecast interregional migration have included efforts by the National Planning Association. They have attempted regression analysis on net migration by states using the relationship between the supporter group (age 20-64) and the dependent age group for alternative historical periods, and then made projections of net migration for states. Another set of multiple regressions on net migration have included change in civilian employment, change in armed forces, and per capita income relative to the U.S. average as the independent variables. The results vary over different time periods, with the coefficient of determination .389 for the period 1965-70, and as high as .856 for the period 1950-60 (National Planning Association Report 72-R-1, 1972). Although net migration can serve as a warning device, its detailed use in planning is open to question (see Chapter III for a detailed discussion). In addition, no formal model is presented and its lack of disaggregation by age and color make its findings of limited use.

Perhaps the best work heretofore in developing a regional migration forecasting model has been implemented by Richard Olsen (Olsen, 1972). A single-equation model of migration is postulated, where causation is assumed to flow from the independent variables to the dependent variables. In addition, inmigration and outmigration by age are related to both characteristics of place and characteristics of persons. The model used 1950 and 1960 census data for State Economic Areas in the Southeast, and pooled the data by using a shift factor which took the value 0 for observations during 1950 and the value 1 for observations during 1960. In this manner a pseudo-time series analysis was implemented. The independent variables operationalized were local minus national unemployment rate, population density, percent of the population that are armed forces, college student population, index of male skills, percent of the population that is nonwhite, and local minus national labor participation rate. Although Olsen specifies a model, the causal relationship between the independent and the dependent variables is not clear. In addition, no disaggregation is developed by race, though this may be quite useful for policy and planning purposes (see Chapter III). Finally, Olsen's forecasts were developer for regions for which little or no political machinery exists to implement the economic policies which the results might suggest.

This study will improve on current forecasting methodology by using a model based on labor market theory, disaggregate inmigration and outmigration by age and race, use states as the geographic region, and implement the 1965-70 PC(2)-2B computer tape data base as an input. In this manner, the model that is to be presented will improve the "state of the art" with respect to migration forecasting. Furthermore, the methodology will be stated explicitly so that alterations and refinements can be developed easily.

Preface to the Operational Model

During the development of regional migration modeling, there has been some discussion concerning the use of alternative estimation procedures. One model operationalized by Okun specifies a simultaneous equation approach (Okun, 1968). In his model Okun developed no causal flow from income growth to migration. Instead he uses two-stage least squares, and relates that wherever an endogenous variable appears as an explanatory variable in the structural equations, the calculated values obtained from the appropriate first stage equations replace the observed values. Each first-stage equation consists of an endogenous variable expressed as a linear function of all the predetermined variables, and it is fitted by ordinary least squares.

In the previous chapter a structural model was defined and solved in its reduced form (see equation 3-11). Using this solution as a foundation, it is apparent that the causal flow goes from lagged economic opportunity and noneconomic factors to migration and that a single equation model is sufficient. With this theoretical construct in mind, we now turn to operationalizing the model with the available data base.

Two different data bases have been used mainly in migration analysis: the tabulations from the one-percent sample of reports on the social security covered labor force, and the Bureau of the Census data published in subject reports PC2-2B. Although the social security data provides yearly tabulations, it first became available as recently as 1957. In addition, the social security data only covers persons in paid employment under social security. Therefore, no persons who are unemployed or are dependents can be accounted for. Since only those persons under social security are tallied, the following major groups of workers are excluded from this file: 1) self-employed; 2) most federal, state and local civilian workers; 3) employees of exempt nonprofit organizations which do not elect coverage; 4) ministers and members of religious orders who do not elect coverage; and 5) railroad workers covered by the Railroad Retirement Act (Office of Business

Economics, 1971). This data base fails to cover over ten percent of persons in paid employment and is not sufficiently complete for a comprehensive analysis. On the other hand, the Bureau of the Census has maintained short-run (i.e., 5-year) in and outmigration data for states since the 1940 census. The data on residence five years prior to the date of the census was asked of all persons in the fifteen percent sample of the population. As a result, this data base is considerably more comprehensive than the social security data, and can be used with more confidence by manpower planners.

Once having chosen to use the Bureau of the Census data, the use of a pooled cross section analysis would appear most appropriate. It has often been stated that cross-sectionally estimated parameters over or underestimate the sensitivity of a dependent variable, i.e., migration rates, to change in socio-economic conditions over time (Lowry, 1966). The rationale for this procedure can be shown graphically in Figure 4-1. Assume the solid portions of lines A and B represent the responsiveness of migration flows from separate sets of time, i and i + t cross-section data. Using only cross-section data one could be tempted to forecast migration flows along line A or B; however, this procedure is incorrect since comparable time-series data would yield a fitted curve--C (Olsen, 1972). Since long-term time-series data are not available for states this procedure may be thought of as a pseudo time-series analysis. This method attempts to minimize the over or under responsiveness of parameters estimated from individual cross sections, while effectively utilizing the abundant supply of explanatory variables present in each cross-section to explain significant shifts over time.

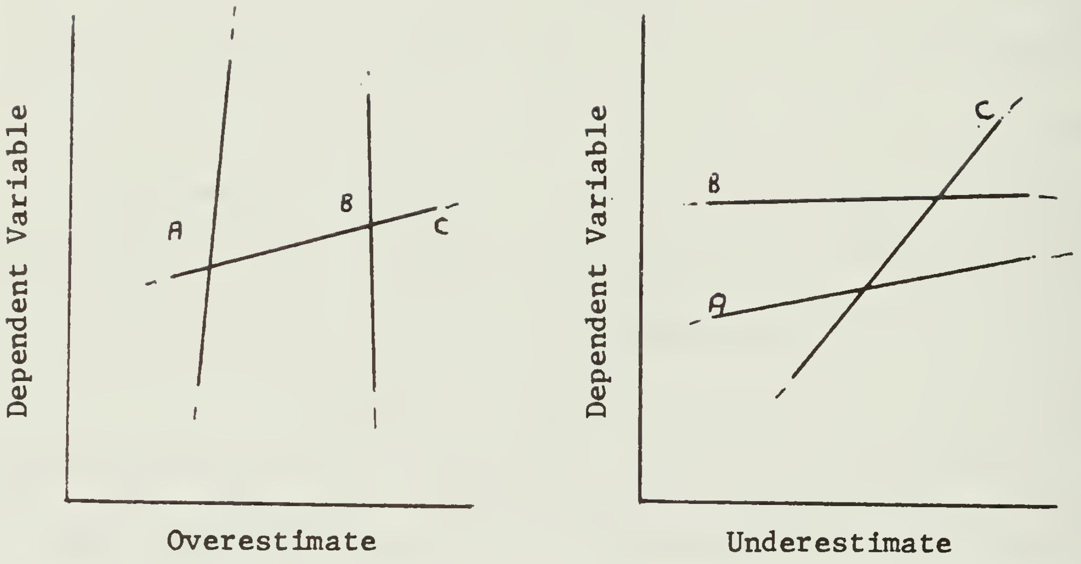


Figure 4-1

The above-mentioned method is referred to as the covariance model. The idea that each cross-sectional unit and each time period are characterized by their own intercept is incorporated into the regression equation by the introduction of binary variables. The regression equation becomes

$$Y_{it} = \beta_1 + \beta_2 X_{1t} + \beta_3 X_{2t} + \ldots + \beta_k X_{it} + \varepsilon_{it},$$

$$X_{it} = 1 \text{ for the } i^{th} \text{ cross sectional unit}$$

$$= 0 \text{ otherwise } (i = 2, 3, \ldots, N).$$

The error term ε_{it} is assumed to satisfy the assumptions of the classical normal linear regression model. If the model is correctly specified and the classical assumptions are satisfied, the ordinary least squares estimates of the regression coefficients will be unbiased and efficient (Kmenta, 1971).

Another statistical problem that is often encountered in working with state data is that the constant variance of the ordinary least squares regression model is not met. When the state size varies from a low of 297,000 for Alaska in 1969 to a high of 19,814,000 for California in 1969, one can expect the smaller states to contain an intrinsically larger variability simply because of population size. Moreover, sampling error is known to be reduced in size as the sample size increases. This problem known as heteroskedasticity does not introduce bias into ordinary least-squares estimates of coefficients, but the estimates of the variance of the least-squares coefficients $\hat{\alpha}_0$, $\hat{\alpha}_1$, ..., $\hat{\alpha}_n$ may be biased downward. The usual t and F tests of significance will tend to give incorrect results. In addition, the forecasting intervals for the model will also be biased downward (Frank, 1971). Under these circumstances, statistical theory implies the use of Generalized Least Squares (G.L.S.). However, the G.L.S. model is often difficult to operationalize, though theoretically preferred. Thus, the use of weighted regression, which is operational and a close approximation to G.L.S. is more appropriate. By using weighted regression the results of the parameter estimates are different, estimates of the standard errors of the parameters are unbiased, and the statistical tests of parameter significance are valid (Wonnacott and Wonnacott, 1970). From this discussion it would appear that the use of migration rates rather than actual migration would be appropriate in developing a migration model.

The Models: Specification

This section will develop two separate models: one for inmigration by age and color and the second one for outmigration by age and color. In this manner the factors that influence each cohort can be examined in view of its affect on each flow. The models will be based on equation 3-11, which specified each of the following equations in general form, and developed the causal flow.

The basic relationship in terms of which inmigration model specification is discussed are:

$$ {}_{r}^{a}\mathrm{InMig}_{t}^{i} = f\,(\Pi_{t}^{i},\ \Delta E_{t-1}^{i},\ ADC_{t-1}^{i},\ TP_{t-5}^{i},\ WD_{t-1}^{i},\ \Delta U_{t-1}^{i},\ {}_{r}\mathrm{LIM}^{i}_{\substack{t-10,\\ t-20,}}\ {}_{r}^{a}\mathrm{PInMig}^{i}_{\substack{t-10,\\ t-20,}}\ T^{i},\ \text{Pooled}) $$

where

${}_{r}^{a}\mathrm{InMig}_{t}^{i}$ = number of persons of a (the designated age group) in r (the designated race: White or Nonwhite) who resided elsewhere on April 1, 1955/1965, and in i (the state in question) on April 1, 1960/1970 divided by the number of persons in that cohort in 1955/1965.

Π_{t}^{i} = natural increase of the labor force population in state i during period t divided by labor force population 1955/1965.

ΔE_{t-1}^{i} = total percent change in employment in state i during period 1954-1959/1964-1969.

ADC^{i}_{t-1} = aid to dependent children in state i during period 1959/1969 divided by the national mean.

TP^{i}_{t-5} = total population of a state on April 1, 1955/1965 relative to the national mean on those dates.

WD^{i}_{t-1} = relative per capita income in state i during period 1959/1969.

ΔU^{i}_{t-1} = change in unemployment in state i during period 1954-1959/1964-1969.

${}_{r}LIM^{i}_{t-10,\ t-20,}$ = lagged inmigration of the cohort in the previous census.

${}^{a}_{r}PInMig^{i}_{t-10,\ t-20,}$ = inmigration of a in r in i during the previous census for which comparable data is available.

T^{i} = mean January temperature in the principal city in state i.

Pooled = shift factor which takes on the value zero for observations during the period 1955/1960 and one for observations during the period 1965/1970.

The model for inmigration will attempt to disaggregate the dependent variable as much as current data collection by the Bureau of the Census will allow. This will include racial disaggregation (white and nonwhite) and age disaggregation of those of labor force age (15-19, 20-24, 25-29, 30-34, 35-39, 40-49, and 50-64). As has been mentioned, the migration data for the model was obtained from Bureau of the Census subject report PC2-2B table 59 computer tapes. The use of this data base allows racial and age disaggregation to be implemented for all fifty states plus the District of Columbia for the period 1965-1970.

A conceptual problem arises categorizing the Negro and Non-Negro data which is presented in the current Census tables, and making it correspond with the Nonwhite and White disaggregation, which has been used in the past. However, this is not a serious practical problem, since well over 90 percent of all nonwhites are Negro and over 95 percent of all Non-Negroes are white; they can serve as adequate proxies. Since the data in the tables are not in the form needed for this analysis several algorithms were developed to derive white, nonwhite, and the disaggregated age migration rates (see Appendix B). In order to obtain the appropriate inmigration rate, total inmigration for that cohort was divided by population at the beginning of the period (i.e., 1955 population for inmigration for the 1955-60 period and 1965 population for inmigration for the 1965-70 period). It should be stated that nonwhite data is not available for twelve states for the period 1955-60 (Bureau of the Census, 1974). These states are Alaska, Hawaii, Idaho, Maine, Montana, Nevada, New Hampshire, North Dakota, Rhode Island, Utah, Vermont, and Wyoming. For these states that have a small nonwhite population the rates for the 1965-70 period for each cohort was used for the observations of the 1955-60 period. By disaggregating the data in this detail, some evaluation can be made as to the quality of migration for each state.

Generally, one could assume that those jobs which cannot be filled by local residents are filled by inmigrants. States which have high natural increases would tend to have relatively smaller inmigration rates. Lowry's regression statistics covering the period 1950-60 have shown that a natural increase of 100 persons in the age-group 15-65 years will have the effect of diminishing the number of net inmigrants by 70 persons (Lowry, 1966). The natural increase variable will be implemented in the following form:

$$\frac{LFP_t^i - LFP_{t-5}^i - {}_{t-5}M_t^i}{LFP_{t-5}^i}$$

where LFP = labor force population,

M = net migration,

t = time coordinate dating variables,

i = designated state.

In this manner the percent of natural increase in the labor force population can be related to the inmigration rate, using this newly available data.

The factor most often cited as being significant in influencing inmigration is the change in employment in a state. This variable relates economic opportunity and economic growth to inmigration. The studies completed thus far have shown this to be important in influencing inmigration, and in turn that inmigration has a positive effect on the change in employment (Lowry, 1966; Klaassen and Drewe, 1973; Weeden, 1973). In order to help clarify the causal flow the employment change has been lagged one year. Though there may be some disagreement concerning the length of the lag, its use in this model results in greater theoretical clarity. The employment change variable was developed in the following form:

$$\frac{E_{t-1}^i - E_{t-6}^i}{E_{t-6}^i}$$

where E = total employment (see Appendix B for data sources and the method of obtaining each year's total),

t = time coordinate dating variables,

i = designated state.

This formulation will relate the relative change in employment to inmigration for each state.

For many poor nonwhites, aid to dependent children (A.F.D.C.) payments in a state has been suggested as being a significant attraction. It has been said that for welfare recipients A.F.D.C. is looked at much like employment opportunities or per capita income for other groups in society. Using inmigration as the dependent variable, Kaun found that A.F.D.C. payments were highly significant in affecting the inmigration of Negroes to S.M.S.A.'s during the 1950's (Kaun, 1970). However, it has recently been shown that about 45 percent of the variation among the States in the average size of welfare payment can be accounted for simply by differences in median family income. This suggests that there is a strong tendency for States with high incomes to offer relatively high welfare payments (Long, 1974). Nevertheless, operationalizing this variable for nonwhites between 15 and 40 will add more evidence to this controversy. The annual A.F.D.C. variable was implemented as follows:

$$\frac{ADC_{t-1}^{i}}{ADC_{t-1}^{j}},$$

where j is the national mean.

The size of the labor market is also assumed to exert an important influence on migration. The larger the size of the labor market, the greater the number of job opportunities that are likely to exist at any given time. However, there is no apriori reason to believe that in migration increases in proportion to, more than in proportion to, or less than in proportion to labor market size. However, previous empirical work on college student migration have shown that relative population size is negatively associated with in and outmigration (Greenwood, 1973). The labor market size variable is

$$\frac{TP^{i}_{t-5}}{TP^{j}_{t-5}} \, .$$

This variable will be operationalized for all white cohorts, and for those nonwhite cohorts over forty.

Theoretical discussions concerning the destination of migrants have generally used the wage or income differential as an explanatory variable. Assuming that economic factors influence migration, the areas with relatively high per capita income should be positively correlated with inmigration. However, some empirical tests have shown that relative income explains a small amount of the total variation in migration (Greenwood, 1969). The relative yearly per capita income used is

$$\frac{Y^{i}_{t-1}}{Y^{j}_{t-1}} \, .$$

Another variable which appeared in the solution in equation 3-11 was unemployment. One would hypothesize that this would be negatively correlated with inmigration. In contrast, most empirical studies have shown the unemployment rate to be insignificant in explaining inmigration (Lowry, 1966; Kaun, 1970; Renshaw, 1974). This model will observe the difference in the unemployment rate over a five year period, and maintain the one year lag that the theory suggests. It will be presented as follows: $U^i_{t-6} - U^i_{t-1}$. In this manner another measure of the change in the regional labor market in the period preceeding the final migration tabulation can be analyzed in some detail.

A factor which has its foundations in demography and economics is the previous migration of a cohort. As was stated in Chapter II there have been certain long-run trends in migration that have been remarkably persistent, and this trend should be recognized and implemented in a forecasting model. Also, the economics of uncertainty plays an important role in migration decisions. Persons tend to migrate where others of the same cohort have gone before them and in this sense there are networks of information. Relatives and friends who have previously moved to an area can provide food and shelter, opportunities for jobs, and companionship. There likely would be an "echo effect" of inmigration over a period of time. Tests of this hypothesis using a "stock" concept of previous migrants by Greenwood have shown that this is the single most important variable with respect to its contribution to the coefficient of determination (Greenwood, 1969). This model will implement two flow concepts. First, the inmigration rate of the current aged cohort in the previous census. For example, the migration rate of persons aged 25-29 in 1970 was aged 15-19 in 1960. The cohorts that were dependent on other age groups in the previous census were related to the appropriate independent age group (e.g., 15-19 dependent group related to 35-39 independent group). Secondly, the inmigration rate of the same age cohort in the previous census was operationalized. That is, the inmigration rate of those persons aged 15-19 in both 1970 and 1960 was used for comparable observations. For the 1965-70 period, the 1955-60 rates were used. However, for the 1955-60 period the 1935-40 rates were used because no five-year migration data exists for the 1950 Census, and the disaggregation by age and race was incomplete for that Census (see Appendix B for a detailed explanation).

Next, most persons regard mild weather as attractive. Generally the cost of living is lower the more temperate the climate, and, therefore, *certeris paribus*, real income would be higher. Also, as persons approach retirement age they would be more highly motivated by quality of life considerations than income or employment opportunities. Furthermore, Fuchs has shown that climate has been an important and positive factor in the redistribution of manufacturing employment in the United States between 1929 and 1954 (Fuchs, 1962). Greenwood furthers the argument by reporting that "of T (temperature) has the second highest elasticity and is highly significant" (Greenwood, 1969).

Finally, a pooled variable will be used as a shift factor which takes on the value 0 for observations during the 1955-60 period and the value 1 for observations during the 1965-70 period. Lawrence Klein has stated that the spread of econometric methods to regions that have a weak data base is likely to depend on the use of time sequences of cross-sections to fill in some irreparable time-series gaps (Klein, 1971). Olsen has used this method to make forecasts in the interior Southeast with some success (Olsen, 1972). This method has sufficient promise so that its inclusion in this study is justified.

In contrast with the economic factors which are assumed to dominate inmigration, outmigration has been hypothesized to be influenced by noneconomic factors. The Lowry hypothesis, which assumes that outmigration is a function of population variables, has thus far been tested on disaggregated 1955-60 data and aggregated 1965-70 Census data (Bramhall and Bryce, 1969; Renshaw, 1974). Renshaw's tests of the Lowry hypothesis have shown that population factors are significant, but that economic factors such as income levels are also important and should not be neglected. Given this backdrop, the specification of the outmigration model is as follows:

$$ {}_{r}^{a}\mathrm{OutMig}_{t}^{i} = f\,(\Pi_{t}^{i},\ \Delta E_{t-1}^{i},\ \mathrm{ADC}_{t-1}^{i},\ \mathrm{TP}_{t-5}^{i},\ \mathrm{WD}_{t-1}^{i},\ U_{t-1}^{i}, $$

$$ {}_{r}\mathrm{LOM}_{\substack{t-10,\\ t-20,}}^{i}\ \ \mathrm{POutMig}_{\substack{t-10,\\ t-20,}}^{i}\ \ T^{i},\ \mathrm{Pooled}) $$

${}_{r}^{a}\mathrm{OutMig}_{t}^{i}$ = number of persons of a in r who resided in i on April 1, 1955/1965 and elsewhere on April 1, 1960/1970.

${}_{r}\mathrm{LOM}_{\substack{t-10\\ t-20}}^{i}$ = lagged outmigration of the cohort in the previous census.

${}_{r}^{a}\mathrm{POutMig}_{\substack{t-10\\ t-20}}^{i}$ = outmigration of a in r in i during the previous census for which comparable data is available.

The notation and algorithms for the other independent variables are the same as for the inmigration equation. The hypotheses concerning the sign of the variables in each equation is as follows. The natural increase in the population is assumed to be positively related to outmigration. Bramhall and Bryce show that population size is the most significant factor in influencing outmigration, and it can be assumed that additions to population through past fertility would have the same effect (Bramhall and Bryce, 1969). Assuming that the Renshaw correlary to the Lowry hypothesis is plausible, ΔE^i_{t-1}, ADC^i_{t-1}, TP^i_{t-5}, WD^i_{t-1}, and U^i_{t-1} will be negatively related to outmigration. In contrast, the outmigration rate of the current aged cohort in the previous census is assumed to be positively related to current outmigration. Also, the outmigration rate of the same age cohort in the previous census is positively related to the same age group. The temperature variable is hypothesized to be negatively related to outmigration. The more temperate the climate the less incentive to move elsewhere. Finally, the pooled variable will be used to reflect any time trend that occurred during the 1955-60 and 1965-70 period.

A summary of the model specification presented in this section is summarized in Chart 4-1. The hypothesized directional effects of the various economic and noneconomic variables on inmigration and outmigration rates are shown.

Chart 4-1

	Π	ΔE	ADC	TP	WD	U	LIM	PInMig	LOM	POutMig	T
InMig	-	+	+	-	+	-	+	+			+
OutMig	+	-	-	-	-	+			+	+	-

The Models: Estimation

This section will present and discuss the results of multiple regression analysis on the models specified in the previous section. Table 4-1 will relate the inmigration functions and Table 4-2 will include the outmigration functions.

Statistical Notation

S.D. = standard deviation

N = number of observations in regression

S.E.E. = standard error of the estimate

R^2 = coefficient of determination

F = F test statistic

b = net (partial) regression coefficients

s = standard error of the regression coefficient

t = t-value of the regression coefficient (b/s)

*** = significant at the 1% level

** = significant at the 5% level

* = significant at the 10% level

Note: For the regression coefficient test for statistical significance, the two-tailed t-test is used.

Table 4-1

Estimated InMigration Functions by State Using Pooled Cross-Section Data

Period
1955-60
1965-70

White Inmigration 15-19

Ind. Var.	Π^{i}_{t}	ΔE^{i}_{t-1}	TP^{i}_{t-5}	WD^{i}_{t-1}	U^{i}_{t-1}	${}_{r}LIM^{i}_{\substack{t-10\\t-20}}$	${}^{a}_{r}PInMig^{i}_{\substack{t-10\\t-20}}$	T^{i}	Pooled
b	.014	.044	-.013	.038	-.002	.048	.731	.005	-.056
s	.013	.023	.004	.025	.036	.127	.099	.003	.008
t	1.09	1.83**	3.33***	1.49*	.60	.379	7.36**	1.46*	7.13***

Other data

Intercept

b = .032
s = .028
t = 1.16

Mean = .142

F = 90.2

S.D. = .106

S.S.E. = .035

R^2 = .90

White Inmigration 20-24

Ind. Var.	Π^{i}_{t}	ΔE^{i}_{t-1}	TP^{i}_{t-5}	WD^{i}_{t-1}	U^{i}_{t-1}	${}_{r}LIM^{i}_{\substack{t-10\\t-20}}$	${}^{a}_{r}PInMig^{i}_{\substack{t-10\\t-20}}$	T^{i}	Pooled
b	.015	.0818	-.021	.034	.009	-.305	.920	.007	-.109
s	.015	.027	.045	.030	.041	.141	.063	.003	.011
t	1.01	3.08***	4.68***	1.14	.237	2.15**	14.7***	1.69**	10.1***

Other data

Intercept

b = .118
s = .032
t = 3.68***

Mean = .264

F = 135.9

S.D. = .147

S.S.E. = .041

R^2 = .92

Table 4-1 (continued)

Estimated InMigration Functions by State Using Pooled Cross-Section Data

Period
1955-60
1965-70

White Inmigration 25-29

Ind. Var.	Π^{i}_{t}	ΔE^{i}_{t-1}	TP^{i}_{t-5}	WD^{i}_{t-1}	U^{i}_{t-1}	${}_{r}LIM^{i}_{\substack{t-10\\t-20}}$	${}^{a}_{r}PInMig^{i}_{\substack{t-10\\t-20}}$	T^{i}	Pooled
b	.011	.074	-.021	.044	.006	.226	.552	.0004	-.062
s	.012	.021	.004	.024	.035	.098	.097	.0003	.009
t	.905	3.42***	5.43***	1.79**	1.83**	2.30**	5.69***	.134	6.98***

Other data

Intercept

b = .123
s = .027
t = 4.6***

Mean = .249
F = 122.69

S.D. = .117
S.S.E. = .034

R^2 = .92

White Inmigration 30-34

Ind. Var.	Π^{i}_{t}	ΔE^{i}_{t-1}	TP^{i}_{t-5}	WD^{i}_{t-1}	U^{i}_{t-1}	${}_{r}LIM^{i}_{\substack{t-10\\t-20}}$	${}^{a}_{r}PInMig^{i}_{\substack{t-10\\t-20}}$	T^{i}	Pooled
b	.123	.076	-.017	.014	.005	.406	.230	.0008	-.047
s	.011	.019	.003	.021	.003	.065	.098	.0003	.008
t	.110	3.89***	4.92***	.65	1.78**	6.20**	2.39**	2.71***	6.16***

Other data

Intercept

b = .645
s = .239
t = 2.70***

Mean = .185
F = 134.2

S.D. = .109
S.S.E. = .030

R^2 = .92

Table 4-1 (continued)

Estimated InMigration Functions by State Using Pooled Cross-Section Data

Period
1955-60
1965-70

White Inmigration 35-39

Ind. Var.	Π^i_t	ΔE^i_{t-1}	TP^i_{t-5}	WD^i_{t-1}	U^i_{t-1}	$_{r}LIM^i_{\substack{t-10\\t-20}}$	$^{a}_{r}PInMig^i_{\substack{t-10\\t-20}}$	T^i	Pooled
b	-.001	.059	-.011	.016	.004	.279	.493	.0007	-.04
s	.013	.022	.004	.026	.0036	.159	.205	.0003	.011
t	.080	2.65***	2.81***	.635	1.19	1.75**	2.40***	2.18**	3.53***

Other data

Intercept

b = .022
s = .268
t = .823

Mean = .148

F = 84.0

S.D. = .102

S.S.E. = .035

R^2 = .89

White Inmigration 40-49

Ind. Var.	Π^i_t	ΔE^i_{t-1}	TP^i_{t-5}	WD^i_{t-1}	U^i_{t-1}	$_{r}LIM^i_{\substack{t-10\\t-20}}$	$^{a}_{r}PInMig^i_{\substack{t-10\\t-20}}$	T^i	Pooled
b	.004	.058	-.007	.013	.005	.208	.428	.0003	-.18
s	.008	.002	.002	.015	.002	.093	.140	.002	.547
t	.564	4.22***	2.96***	.87	2.26**	2.24**	3.05***	1.68**	3.29***

Other data

Intercept

b = .016
s = .016
t = .96

Mean = .095

F = 102.4

S.D. = .067

S.S.E. = .021

R^2 = .91

Table 4-1 (continued)

Estimated InMigration Functions by State Using Pooled Cross-Section Data

Period
1955-60
1965-70

White Inmigration 50-64

Ind. Var.	Π^{i}_{t}	ΔE^{i}_{t-1}	TP^{i}_{t-5}	WD^{i}_{t-1}	U^{i}_{t-1}	${}_{r}LIM^{i}_{\substack{t-10\\t-20}}$	${}_{r}^{a}PInMig^{i}_{\substack{t-10\\t-20}}$	T^{i}	Pooled
b	.0024	.044	-.0094	.027	.006	.482	.008	.0007	-.020
s	.018	.032	.0056	.035	.005	.146	.131	.0005	.011
t	.131	1.35*	1.68**	.753	1.21	3.29***	.05	1.37*	1.86**

Other data

Intercept

b = .036
s = .038
t = .09

Mean = .066
F = 10.49

S.D. = .068
S.S.E. = .050

R^2 = .51

Nonwhite Inmigration 15-19

Ind. Var.	Π^{i}_{t}	ΔE^{i}_{t-1}	ADC^{i}_{t-1}	WD^{i}_{t-1}	U^{i}_{t-1}	${}_{r}LIM^{i}_{\substack{t-10\\t-20}}$	${}_{r}^{a}PInMig^{i}_{\substack{t-10\\t-20}}$	T^{i}	Pooled
b	.016	.015	-.002	.017	-.0016	.0018	.997	.0003	-.014
s	.017	.029	.022	.037	.005	.092	.069	.0005	.010
t	.94	.50	.086	.02	.32	.02	14.35***	.55	1.35*

Other data

Intercept

b = -.0008
s = .036
t = .02

Mean = .236
F = 36.7

S.D. = .146
S.S.E. = .048

R^2 = .78

Table 4-1 (continued)

Estimated InMigration Functions by State Using Pooled Cross-Section Data

Period
1955-60
1965-70

Nonwhite Inmigration 20-24

Ind. Var.	Π^i_t	ΔE^i_{t-1}	ADC^i_{t-1}	WD^i_{t-1}	U^i_{t-1}	${}_rLIM^i_{\substack{t-10\\t-20}}$	${}^a_rPInMig^i_{\substack{t-10\\t-20}}$	T^i	Pooled
b	.022	.024	.007	.029	-.002	-.106	.906	.0008	-.03
s	.018	.030	.022	.038	.0048	.134	.040	.005	.010
t	1.23	.79	.33	.78	.49	.787	22.65***	.18	2.74***

Other data

Intercept

b = .008
s = .037
t = .23

Mean = .158
F = 90.8

S.D. = .088
S.S.E. = .049

R^2 = .90

Nonwhite Inmigration 25-29

Ind. Var.	Π^i_t	ΔE^i_{t-1}	ADC^i_{t-1}	WD^i_{t-1}	U^i_{t-1}	${}_rLIM^i_{\substack{t-10\\t-20}}$	${}^a_rPInMig^i_{\substack{t-10\\t-20}}$	T^i	Pooled
b	.023	.022	.0054	.024	-.006	-.073	.891	-.0005	-.004
s	.016	.026	.019	.035	.0043	.072	.076	.0004	.0092
t	1.45*	.826	.28	.68	1.42*	1.01	11.66***	.12	.41

Other data

Intercept

b = -.003
s = .033
t = .09

Mean = .158
F = 37.4

S.D. = .088
S.S.E. = .043

R^2 = .79

Table 4-1 (continued)

Estimated InMigration Functions by State Using Pooled Cross-Section Data

Period
1955-60
1965-70

Nonwhite Inmigration 30-34

Ind. Var.	Π^{i}_{t}	ΔE^{i}_{t-1}	ADC^{i}_{t-1}	WD^{i}_{t-1}	U^{i}_{t-1}	${}_{r}LIM^{i}_{\substack{t-10\\t-20}}$	${}^{a}_{r}PInMig^{i}_{\substack{t-10\\t-20}}$	T^{i}	Pooled
b	.017	.016	-.003	.017	-.004	-.012	.93	.0001	.0009
s	.013	.022	.016	.028	.004	.028	.057	.0004	.008
t	1.29*	.709	.204	.63	1.02	.43	16.28***	.38	.11

Other data

Intercept

b = -.0115
s = .027
t = .43

Mean = .117

F = 44.5

S.D. = .080

S.S.E. = .036

R^2 = .81

Nonwhite Inmigration 35-39

Ind. Var.	Π^{i}_{t}	ΔE^{i}_{t-1}	ADC^{i}_{t-1}	WD^{i}_{t-1}	U^{i}_{t-1}	${}_{r}LIM^{i}_{\substack{t-10\\t-20}}$	${}^{a}_{r}PInMig^{i}_{\substack{t-10\\t-20}}$	T^{i}	Pooled
b	.013	.010	.0012	.012	-.002	-.033	.969	.0007	.001
s	.011	.018	.014	.026	.003	.061	.077	.0003	.006
t	1.14	.56	.09	.48	.70	.542	12.62***	.24	.18

Other data

Intercept

b = -.009
s = .024
t = .37

Mean = .091

F = 40.7

S.D. = .064

S.S.E. = .030

R^2 = .80

Table 4-1 (continued)

Estimated InMigration Functions by State Using Pooled Cross-Section Data

Period
1955-60
1965-70

Nonwhite Inmigration 40-49

Ind. Var.	Π^{i}_{t}	ΔE^{i}_{t-1}	ADC^{i}_{t-1}	WD^{i}_{t-1}	U^{i}_{t-1}	${}_{r}LIM^{i}_{\substack{t-10\\t-20}}$	${}^{a}_{r}PInMig^{i}_{\substack{t-10\\t-20}}$	T^{i}	Pooled
b	.007	.006	-.0007	.002	-.001	.028	.889	.0008	-.002
s	.007	.011	.002	.013	.002	.067	.112	.0002	.004
t	1.00	.511	.003	.157	.569	.423	7.90***	.50	.414

Other data

Intercept

b = -.004
s = .014
t = .313

Mean = .062
F = 56.4

S.D. = .046
S.S.E. = .018

R^2 = .85

Nonwhite Inmigration 50-64

Ind. Var.	Π^{i}_{t}	ΔE^{i}_{t-1}	ADC^{i}_{t-1}	WD^{i}_{t-1}	U^{i}_{t-1}	${}_{r}LIM^{i}_{\substack{t-10\\t-20}}$	${}^{a}_{r}PInMig^{i}_{\substack{t-10\\t-20}}$	T^{i}	Pooled
b	.002	.007	-.0002	.0138	-.002	.033	.655	.0001	-.011
s	.007	.012	.002	.013	.002	.053	.081	.0002	.004
t	.31	.59	.08	1.07	1.03	.63	8.08***	.61	2.83***

Other data

Intercept

b = -.007
s = .014
t = .47

Mean = .036
F = 13.27

S.D. = .028
S.S.E. = .019

R^2 = .57

Table 4-2

Estimated OutMigration Functions by State Using Pooled Cross-Section Data

Period
1955-60
1965-70

White Outmigration 15-19

Ind. Var.	Π^i_t	ΔE^i_{t-1}	TP^i_{t-5}	WD^i_{t-1}	U^i_{t-1}	${}_rLOM^i_{\substack{t-10\\t-20}}$	${}^a_rPOutMig^i_{\substack{t-10\\t-20}}$	T^i	Pooled
b	-.016	-.0009	-.301	.055	.019	.429	.301	.0007	-.045
s	.014	.024	.004	.027	.004	.08	.128	.0003	.009
t	1.11	.036	2.21**	2.07**	.471	5.30***	2.34***	1.98**	4.72***

Other data

Intercept

b = .012
s = .029
t = .398

Mean = .136
F = 33.4

S.D. = .077
S.S.E. = .039

R^2 = .77

White Outmigration 20-24

Ind. Var.	Π^i_t	ΔE^i_{t-1}	TP^i_{t-5}	WD^i_{t-1}	U^i_{t-1}	${}_rLOM^i_{\substack{t-10\\t-20}}$	${}^a_rPOutMig^i_{\substack{t-10\\t-20}}$	T^i	Pooled
b	-.016	-.087	-.022	-.102	-.004	.691	.103	-.0007	-.020
s	.007	.036	.007	.043	.006	.137	.066	.0005	.015
t	.70	2.24***	3.18***	2.38***	.65	5.04***	1.56**	1.24	1.32*

Other data

Intercept

b = .341
s = .048
t = 7.08**

Mean = .263
F = 13.78

S.D. = .092
S.S.E. = .963

R^2 = .58

Table 4-2 (continued)

Estimated OutMigration Functions by State Using Pooled Cross-Section Data

Period
1955-60
1965-70

White Outmigration 25-29

Ind. Var.	Π^{i}_{t}	ΔE^{i}_{t-1}	TP^{i}_{t-5}	WD^{i}_{t-1}	U^{i}_{t-1}	${}_{r}LOM^{i}_{\substack{t-10\\t-20}}$	${}^{a}_{r}POutMig^{i}_{\substack{t-10\\t-20}}$	T^{i}	Pooled
b	.009	-.010	-.014	.133	-.009	.910	.686	.001	-.128
s	.033	.055	.010	.057	.009	.286	.121	.0008	.022
t	.268	.188	1.33*	2.28***	1.02	3.18***	5.69***	1.29*	5.88**

Other data

Intercept

b = -.049
s = .066
t = .74

Mean = .281

F = 35.4

S.D. = .181

S.S.E. = .090

R^2 = .77

White Outmigration 30-34

Ind. Var.	Π^{i}_{t}	ΔE^{i}_{t-1}	TP^{i}_{t-5}	WD^{i}_{t-1}	U^{i}_{t-1}	${}_{r}LOM^{i}_{\substack{t-10\\t-20}}$	${}^{a}_{r}POutMig^{i}_{\substack{t-10\\t-20}}$	T^{i}	Pooled
b	-.011	-.015	-.016	.120	-.008	-.147	1.10	.001	-.036
s	.029	.048	.009	.055	.008	.088	.097	.0007	.019
t	.37	.31	1.86**	2.18**	.96	1.67**	11.49***	1.84**	1.91**

Other data

Intercept

b = -.073
s = .062
t = 1.17

Mean = .200

F = 34.80

S.D. = .158

S.S.E. = .079

R^2 = .77

Table 4-2 (continued)

Estimated OutMigration Functions by State Using Pooled Cross-Section Data

Period
1955-60
1965-70

White Outmigration 35-39

Ind. Var.	Π^i_t	ΔE^i_{t-1}	TP^i_{t-5}	WD^i_{t-1}	U^i_{t-1}	$r^{LOM^i_{t-10}}_{\;t-20}$	$r^{{}^aPOutMig^i_{t-10}}_{\;t-20}$	T^i	Pooled
b	-.011	-.020	-.014	.144	-.005	.242	.634	.001	-.059
s	.024	.040	.007	.047	.006	.17	.254	.0006	.017
t	.467	.50	2.00**	3.16***	.759	1.43*	2.50***	2.47***	3.55***

Other data

Intercept

b = -.112
s = .049
t = 2.24***

Mean = .157
F = 32.01

S.D. = .127
S.S.E. = .065

R^2 = .76

White Outmigration 40-49

Ind. Var.	Π^i_t	ΔE^i_{t-1}	TP^i_{t-5}	WD^i_{t-1}	U^i_{t-1}	$r^{LOM^i_{t-10}}_{\;t-20}$	$r^{{}^aPOutMig^i_{t-10}}_{\;t-20}$	T^i	Pooled
b	.0006	.008	-.005	.061	-.003	.322	.492	.0003	-.030
s	.012	.02	.004	.022	.033	.077	.145	.0003	.007
t	.04	.38	1.30*	2.8***	.88	4.21***	3.39***	1.15	4.13***

Other data

Intercept

b = -.044
s = .024
t = 1.88**

Mean = .102
F = 63.02

S.D. = .082
S.S.E. = .032

R^2 = .87

Table 4-2 (continued)

Estimated OutMigration Functions by State Using Pooled Cross-Section Data

Period
1955-60
1965-70

White Outmigration 50-64

Ind. Var.	Π^{i}_{t}	ΔE^{i}_{t-1}	TP^{i}_{t-5}	WD^{i}_{t-1}	U^{i}_{t-1}	${}_{r}LOM^{i}_{\substack{t-10\\t-20}}$	${}^{a}_{r}POutMig^{i}_{\substack{t-10\\t-20}}$	T^{i}	Pooled
b	.0010	.002	-.009	.080	.002	.654	-.070	-.0002	-.024
s	.027	.034	.006	.038	.006	.124	.119	.0005	.012
t	.047	.045	1.53*	2.12**	.347	5.27***	.584	.38	1.94**

Other data

Intercept			
b = -.029	Mean = .070	S.D. = .074	R^2 = .48
s = .041	F = 9.23	S.S.E. = .056	
t = .713			

Nonwhite Outmigration 15-19

Ind. Var.	Π^{i}_{t}	ΔE^{i}_{t-1}	ADC^{i}_{t-1}	WD^{i}_{t-1}	U^{i}_{t-1}	${}_{r}LOM^{i}_{\substack{t-10\\t-20}}$	${}^{a}_{r}POutMig^{i}_{\substack{t-10\\t-20}}$	T^{i}	Pooled
b	-.540	-.020	-.041	.028	-.003	.161	.230	-.0003	.009
s	.016	.027	.019	.034	.004	.068	.071	.0004	.0010
t	.339	.742	2.13**	.833	.643	2.38***	3.23**	.651	.889

Other data

Intercept			
b = .073	Mean = .082	S.D. = .052	R^2 = .38
s = .034	F = 6.15	S.S.E. = .043	
t = 2.12**			

Table 4-2 (continued)

Estimated OutMigration Functions by State Using Pooled Cross-Section Data

Period
1955-60
1965-70

Nonwhite Outmigration 20-24

Ind. Var.	Π^i_t	ΔE^i_{t-1}	ADC^i_{t-1}	WD^i_{t-1}	U^i_{t-1}	${}_r LOM^i_{\substack{t-10\\t-20}}$	${}^a_r POutMig^i_{\substack{t-10\\t-20}}$	T^i	Pooled
b	.0049	-.056	-.062	-.079	-.024	.263	.575	-.0003	-.039
s	.028	.047	.033	.060	.008	.190	.083	.0007	.017
t	.176	1.21	1.86**	1.32*	3.11***	1.39*	6.93***	.334	2.36***

Other data

Intercept

b = .220
s = .063
t = 3.51***

Mean = .189
F = 18.6

S.D. = .122
S.S.E. = .076

R^2 = .65

Nonwhite Outmigration 25-29

Ind. Var.	Π^i_t	ΔE^i_{t-1}	ADC^i_{t-1}	WD^i_{t-1}	U^i_{t-1}	${}_r LOM^i_{\substack{t-10\\t-20}}$	${}^a_r POutMig^i_{\substack{t-10\\t-20}}$	T^i	Pooled
b	.007	.024	-.049	-.009	.001	.382	.710	-.0004	-.017
s	.025	.042	.030	.053	.007	.106	.087	.0007	.016
t	.291	.570	1.66**	.177	.207	3.61***	8.19***	.586	1.10

Other data

Intercept

b = .120
s = .055
t = 2.17**

Mean = .191
F = 22.2

S.D. = .115
S.S.E. = .068

R^2 = .69

Table 4-2 (continued)

Estimated OutMigration Functions by State Using Pooled Cross-Section Data

Period
1955-60
1965-70

Nonwhite Outmigration 30-34

Ind. Var.	Π^{i}_{t}	ΔE^{i}_{t-1}	ADC^{i}_{t-1}	WD^{i}_{t-1}	U^{i}_{t-1}	${}_{r}LOM^{i}_{\substack{t-10\\t-20}}$	${}^{a}_{r}POutMig^{i}_{\substack{t-10\\t-20}}$	T^{i}	Pooled
b	.006	.020	-.029	.040	-.004	.007	.672	-.0002	-.002
s	.018	.029	.021	.038	.005	.063	.084	.0005	.010
t	.357	.677	1.39*	1.04	.829	.105	8.03***	.471	.226

Other data

Intercept

b = .041
s = .039
t = 1.03

Mean = .131
F = 17.4

S.D. = .072
S.S.E. = .048

R^2 = .63

Nonwhite Outmigration 35-39

Ind. Var.	Π^{i}_{t}	ΔE^{i}_{t-1}	ADC^{i}_{t-1}	WD^{i}_{t-1}	U^{i}_{t-1}	${}_{r}LOM^{i}_{\substack{t-10\\t-20}}$	${}^{a}_{r}POutMig^{i}_{\substack{t-10\\t-20}}$	T^{i}	Pooled
b	-.001	.003	.012	-.018	-.002	.038	.979	.0002	-.031
s	.021	.036	.026	.046	.006	.098	.114	.0006	.013
t	.049	.092	.461	.388	.410	.390	8.62***	.404	2.47***

Other data

Intercept

b = .022
s = .047
t = .459

Mean = .116
F = 26.1

S.D. = .105
S.S.E. = .058

R^2 = .72

Table 4-2 (continued)

Estimated OutMigration Functions by State Using Pooled Cross-Section Data

Period
1955-60
1965-70

Nonwhite Outmigration 40-49

Ind. Var.	Π^{i}_{t}	ΔE^{i}_{t-1}	ADC^{i}_{t-1}	WD^{i}_{t-1}	U^{i}_{t-1}	${}_{r}LOM^{i}_{\substack{t-10\\t-20}}$	${}^{a}_{r}POutMig^{i}_{\substack{t-10\\t-20}}$	T^{i}	Pooled
b	.007	.033	-.002	.005	.0006	.371	.508	-.0005	-.015
s	.014	.023	.0040	.024	.004	.054	.091	.0003	.008
t	.50	1.46*	.465	.221	.163	6.93***	5.59***	1.62*	1.85**

Other data

Intercept

b = .013
s = .030
t = .421

Mean = .072
F = 23.8

S.D. = .065
S.S.E. = .037

R^2 = .71

Nonwhite Outmigration 50-64

Ind. Var.	Π^{i}_{t}	ΔE^{i}_{t-1}	ADC^{i}_{t-1}	WD^{i}_{t-1}	U^{i}_{t-1}	${}_{r}LOM^{i}_{\substack{t-10\\t-20}}$	${}^{a}_{r}POutMig^{i}_{\substack{t-10\\t-20}}$	T^{i}	Pooled
b	-.002	.016	-.004	.0002	-.0003	.140	.349	-.0005	-.0168
s	.008	.013	.002	.013	.002	.051	.095	.0002	.005
t	.315	1.23	1.72**	.016	.138	2.74***	3.37***	.301	3.37***

Other data

Intercept

b = .028
s = .016
t = 1.71**

Mean = .037
F = 5.79

S.D. = .025
S.S.E. = .021

R^2 = .36

Interpretation

The model for inmigration exhibits low standard errors of the estimate, high F statistics, and at least five of the independent variables significant at the 10 percent level or better for whites and at least two are significant for nonwhites. It is unfortunate the model has difficulty securing good results for all age-race groups. However, the poorest results are obtained for the oldest age groups, which is consistent with human capital theory. The coefficient of determination is consistently high for most white age groups and declines somewhat for nonwhites. Given that the data is essentially cross-sectional, the fit of the equations are generally quite good.

In terms of goodness of fit the R^2 for the outmigration model is consistently lower than the model for inmigration. However, the standard errors of the estimate remain quite small in magnitude, and the F statistics are high. It can be noted for the sake of our underlying theoretical construction and the selection of variables, that for each age-color group usually six and often more of the independent variables are statistically significant at around the ten percent level or better. Although in both models the t-values indicate that some variables are more consistent in their "importance" over the various age-color cohorts than others, all the variables seem to be sufficiently justified as to their inclusion in the general model.

An examination of the correlation matrix shows the existence of some multicollinearity especially among the demographic variables (Farrar and Glauber, 1967). However, if one wishes to use a regression equation for purposes of prediction, the power of the prediction will be enhanced if both variables are included (Frank, 1971). This is especially true if the correlation between the variables is expected to continue in the future as it has in the past data on which the estimated equation is based. The sensitivity of regression coefficients in contexts where multicollinearity exists often makes the variance of estimates quite large and it is difficult to determine the significance of variables. However, it does not destroy the unbiasedness and efficiency of least-squares estimators. These considerations, as well as the additional complexity of dealing with reduced form parameters, should not preclude a modest attempt to provide some insights into the relationships via the regression coefficients and their signs.

Natural Increase (Π)

For both white and nonwhite inmigration the natural increase is positively related to inmigration, though it is rarely significant. The outmigration functions are many times positive as hypothesized, however, it is never statistically significant. The suggestion of an effect of the natural increase on migration is not supported by the results of Tables 4-1 and 4-2, although future research on other data sets may be useful.

Percent Change in Employment (ΔE)

The percent change in employment is positive and strongly significant for all age groups of white inmigration. In addition, the coefficients are stable for both white and nonwhite cohorts and the signs are in the postulated direction. In Table 4-2 the outmigration functions are generally negative as hypothesized; however, it does not appear to be as potent in explaining outmigration rates. The results suggest that employment change will have an important effect on inmigration, and that outmigration is reduced as jobs are created in a state.

Aid to Dependent Children (A.D.C.)

Table 4-1 shows that relative A.D.C. is positively related to the inmigration rate for nonwhites for three of the five cohorts tested. In none of the cases is A.D.C. statistically significant with respect to inmigration. On the other hand, A.D.C. is negative and significant in four of five of the outmigration cases. However, care should be taken due to the high collinearity of A.D.C. with per capita income (i.e., simple correlation .61) to attach policy implications to these results.

Relative Population (TP)

Tables 4-1 and 4-2 show that relative population is negatively related and generally statistically significant for both inmigration and outmigration rates. Overcrowding and the externalities which result may adversely influence inmigration. Moreover, the larger the size of the labor market, the greater the number of individuals who are likely to have any given reason to leave, and hence the greater the outmigration rates.

Per Capita Income (WD)

For white and nonwhite inmigration per capita income is positive as hypothesized, and is statistically significant in two of fourteen cases. For white outmigration per capita income is significant in five of seven cases but is negative as hypothesized only for the 20-24 age cohort. Persons with high incomes also tend to be more mobile and able to move out of an area when an opportunity arises. This is substantiated by lower income nonwhites being affected in the hypothesized direction, and staying in high income areas as is suggested by Table 4-2.

Unemployment (U)

Table 4-1 shows an interesting contrast for white and nonwhite inmigration. For whites the change in unemployment is positively related to inmigration in all cases whereas U is negatively related to nonwhite inmigration for the seven cohorts. This may reflect the existence of dual labor markets for whites and nonwhites. For whites, the change in employment seems more important, and they are less sensitive to a declining regional labor market. For nonwhites, marginal productivity is often less and they can be assumed to be more sensitive to variations in state labor markets. The signs of the outmigration functions vary for both whites and nonwhites and no firm conclusions can be drawn from the results.

Lagged and Past Migration (LIM, PInMig, LOM, POutMig)

In general, lagged and past migration variables were significant and of the hypothesized signs. For white inmigration both the lagged and past variables were significant in six of the seven cases and possessed the hypothesized sign. Past inmigration dominates the other variables for the nonwhite cohorts, and this may cause errors in forecasting. The white outmigration functions show the lagged variable being universally significant, while the past migration variable is significant in six of the seven groups. As with nonwhite inmigration, the past migration variable dominates the others for nonwhite outmigration, though the lagged variable is significant for six of the seven groups and possesses the hypothesized sign.

Temperature (T)

The temperature variable is statistically significant and positive for six of the seven white inmigration cohorts, but for nonwhites temperature is not statistically significant. Although temperature is positively related to white outmigration, it has the hypothesized negative sign for those persons 50-64. For nonwhites temperature is negative for five of the seven cohorts but significant only once. So, in essence, the evidence only supports the hypothesis that temperature influences inmigration for whites.

Pooled

The pooled variable was included to capture any time trend that remained after including all previously mentioned variables. Somewhat surprisingly, all but three of the twenty-eight coefficients were negative, and only seven were not significantly different from zero. The negative sign implies that after adjusting for changes in all of the variables considered, there has been a decline over time in the propensity to migrate. The size of the decline, however, has been small.

Other Comments

As formulated, the model does not permit a detailed assessment of the relative impacts of variables according to age. It is apparent that each variable is not equally important at all age groups, and that future research needs to be devoted to converting this rather general model into specific models for each age group. Nevertheless, the results add considerable support to the validity of a socioeconomic model to the explanation and prediction of migration, and to the underlying theoretical construction based on regional labor market theory.

CHAPTER V

THE TESTS AND IMPLEMENTATION OF THE MIGRATION FORECASTS

Introduction

In the previous chapter a model for forecasting purposes was specified and estimated. This section will develop a method for an analysis and implementation of the forecast. Theil has stated that three main problems exist in analyzing a forecast. First, there is the verification and accuracy analysis; second, the analysis of the generation of predictions; and finally, the use of forecasts for policy purposes (Theil, 1965). Within this context the interstate migration forecasting model will be tested and forecasts developed for Illinois using alternative economic scenarios for the state.

Verification and Accuracy Analysis

The method of verification amounts to testing the hypothesis that the forecasting procedure is correct, whereas accuracy deals with the degree to which the forecasts are not perfect. A forecast is perfect if it turns out to be identical with the quantity to be predicted. In all other cases it is imperfect, which is most often the case. In particular, an interval prediction, which is developed here, is never perfect except when it degenerates to a point prediction and coincides with the phenomenon to be predicted.

One of the measures that has sometimes been used for analyzing the accuracy of forecasts is the classical correlation coefficient of the series of predictions and actual outcomes. Its disadvantage is that perfect correlation does not imply perfect forecasting, but only the existence of an exact linear relation with positive slope between the individual predictions (P_i) and the actual values (A_i),

$$P_i = \alpha + \beta A_i \qquad \beta > 0$$

whereas perfect forecasting requires, in addition to this, $\alpha = 0$ and $\beta = 1$. An alternative coefficient, developed by H. Theil, and hereafter referred to as Theil's U statistic, is the following:

$$U = \frac{\sqrt{1/n \, \Sigma \, (P_i - A_i)^2}}{\sqrt{1/n \, \Sigma \, P_i^2} + \sqrt{1/n \, \Sigma \, A_i^2}} ,$$

$P_1, \ldots, P_n$ being the predictions and $A_1, \ldots, A_n$ the corresponding actual outcomes, is preferable in this respect. This U coefficient is often called the inequality coefficient of the series P_i, A_i. It is to be considered as an estimator of the parent coefficient

$$Y = \frac{\sqrt{(U_{20} + U_{02} - 2U_{11})}}{\sqrt{U_{20}} + \sqrt{U_{02}}}$$

where the moment U_{hk} stands for the mean value of $P^h A^k$. Theil has shown that the following inequality holds for the variance of U under the assumptions of independence and bivariate normality:

$$\text{var } U \leq \frac{1}{n} Y^2 (1 - Y^2)^2 \qquad \text{(Theil, 1965, p. 43).}$$

Theil's U coefficient--except for the trivial case where all P's and A's are zero, when it is determinate--is confined to the closed interval between zero and unity. If $U = 0$ in the case of equality: $P_i = A_i$, then this is the case of perfect forecasts. If $U = 1$ ("the maximum of inequality") there is either negative proportionality, or if one of the variables is identically zero: $r P_i + s A_i = 0$ for all i and for some nonnegative r and s (not both zero). In other words, U = 1 if there is a nonpositive proportionality between the P's and the A's, and this would be a case of very bad forecasting. Therefore, this would mean that zero predictions of nonzero actual values are made (s = 0) or that nonzero predictions are made of actual values which are always zero and hence easy to predict, or that predictions are positive or negative if actual outcomes are negative or positive in a regular manner. Furthermore, it is clear that Theil's U statistic, contrary to the correlation coefficient, is not invariant against additive variations.

The Method of Testing the Forecasting Model

Since the U statistic has these verification and accuracy properties it will be used to test the following forecasting model. The forecast will begin with a vector of $P_i^{(t-5)}$ where $\underset{(7x1)}{P}$ is the population of the designated cohort in i the designated state at t-5 the commencement of the projection year 1965. The age-color migration rates M_i^t, where $\underset{(1x7)}{M}$ is a row of migration rates, are applied to the population estimate at the beginning of the period to ascertain migration population at the end of the five-year period P_i^t. The general form of the model is the following:

$$P_i^{(t)} = M_i^{(t)} \cdot P_i^{(t-5)}$$

that is, the population of the given age group is multiplied by the probability that a certain number of persons will in or out migrate at the end of the five year period. The process of applying migration rates to an age distributed population forward through five year time intervals may be expressed in matrix form

$$\underline{P}^{(t)} = \underline{M}^{(t)} \cdot \underline{P}^{(t-5)}$$

where

$$\underset{(1x7)}{M^{(t)}} = [M_1, M_2, \ldots, M_7]^t$$

and

$$\underset{(7x1)}{P^{(t-5)}} = \begin{bmatrix} P_1 \\ P_2 \\ \cdot \\ \cdot \\ \cdot \\ P_7 \end{bmatrix}^{(t-5)}$$

where $$\underset{(7x7)}{P^{(t)}} = \begin{bmatrix} M_1P_1 & M_2P_1 & \cdots\cdots & M_7P_1 \\ M_1P_2 & M_2P_2 & & \cdot \\ \cdot & \ddots & & \cdot \\ \cdot & & \ddots & \cdot \\ \cdot & & & \cdot \\ M_1P_7 & \cdots\cdots & \cdots\cdots & M_7P_7 \end{bmatrix}^{(t)}$$

In this case the diagonal elements of matrix operator $\underline{P}^{(t)}$ are the in or out migrants for the particular state at the end of the five-year period.

In order to test the accuracy of the regression model in Chapter IV for forecasting purposes a limited version that contains 87 observations will be obtained. Fifteen of the states that required no interpolation of past rates will be removed, and migration rate forecasts for the 1965-70 period developed using the coefficients of the new model (R_2). This method will be used so that a time trend can be maintained by using 1955-60 and 1965-70 data and the binary variable.

Applying these rates to the base year population migration forecasts will be obtained for this five-year period. A comparison will be made with a naive method, i.e., past-rates for the 1955-60 period, using Theil's U-statistic as a criteria for evaluation. The U-statistic will be applied to each age group and race by state thereby obtaining a U-statistic for total inmigration and outmigration by state.

The states that will be analyzed will include Alabama, Arizona, California, Connecticut, Florida, Illinois, Indiana, Kansas, Kentucky, Maryland, Massachusetts, Michigan, Oregon, Virginia, and Wisconsin. These states include over forty percent of the total population of the United States, and their removal from the model will no doubt adversely affect its fit and its accuracy for forecasting purposes. However, it was thought that greater testing of the model across all regions of the country with more observations would enhance the verification properties of the model. The form of the specific U-statistic used to test the past rates method and the regression method is the following:

$$U = \frac{\sqrt{1/14 \sum_{1}^{14} (P_1 - A_1)^2}}{\sqrt{1/14 \sum_{1}^{14} P_1^2} + \sqrt{1/14 \sum_{1}^{14} A_1^2}} .$$

The models for inmigration and outmigration were fitted using the same independent variables as in Chapter IV. The results for this limited model (R_2) are presented in Tables 5-1 and 5-2.

Interpretation

For the most part Tables 5-1 and 5-2 are consistent in their results with Tables 4-1 and 4-2. By way of comparison, the R_2 functions

Table 5-1

Estimated InMigration Functions by State Using Pooled Cross-Section Data

R_2

Period
1955-60
1965-70

White Inmigration 15-19

Ind. Var.	Π^{i}_{t}	ΔE^{i}_{t-1}	TP^{i}_{t-5}	WD^{i}_{t-1}	U^{i}_{t-1}	${}_{r}LIM^{i}_{\substack{t-10\\t-20}}$	${}^{a}_{r}PInMig^{i}_{\substack{t-10\\t-20}}$	T^{i}	Pooled
b	-.0024	-.027	.002	-.042	.0045	.102	.774	-.0002	-.055
s	.010	.023	.004	.026	.039	.140	.111	.0003	.009
t	.229	1.18	.523	1.60*	1.14	.729	6.94***	.596	6.03***

Other data

Intercept

b = .121
s = .032
t = 3.83***

Mean = 14.5
F = 73.2
N = 87

S.D. = .11
S.S.E. = .038

$R^2 = .90$

White Inmigration 20-24

Ind. Var.	Π^{i}_{t}	ΔE^{i}_{t-1}	TP^{i}_{t-5}	WD^{i}_{t-1}	U^{i}_{t-1}	${}_{r}LIM^{i}_{\substack{t-10\\t-20}}$	${}^{a}_{r}PInMig^{i}_{\substack{t-10\\t-20}}$	T^{i}	Pooled
b	-.003	.004	.0002	.007	.001	.094	.853	.0001	-.098
s	.014	.030	.005	.033	.005	.197	.084	.0004	.015
t	.242	.122	.042	.216	.254	.476	10.17***	.308	6.70***

Other data

Intercept

b = .126
s = .040
t = 3.15***

Mean = .27
F = 86.32
N = 87

S.D. = .155
S.S.E. = .049

$R^2 = .91$

Table 5-1 (continued)

Estimated InMigration Functions by State Using Pooled Cross-Section Data

R_2

Period
1955-60
1965-70

White Inmigration 25-29

Ind. Var.	Π^i_t	ΔE^i_{t-1}	TP^i_{t-5}	WD^i_{t-1}	U^i_{t-1}	${}_{r}LIM^{i}_{\substack{t-10\\t-20}}$	${}^{a}_{r}PInMig^{i}_{\substack{t-10\\t-20}}$	T^i	Pooled
b	-.0009	.019	-.003	.018	-.004	.065	.829	-.0004	-.078
s	.011	.025	.005	.029	.004	.123	.116	.0004	.011
t	.079	.752	.560	.614	.932	.530	7.15***	.985	7.04***

Other data

Intercept

b = .115
s = .036
t = 3.20***

Mean = .254
F = 77.8
N = 87

S.D. = .124
S.S.E. = .042

$R^2 = .90$

White Inmigration 30-34

Ind. Var.	Π^i_t	ΔE^i_{t-1}	TP^i_{t-5}	WD^i_{t-1}	U^i_{t-1}	${}_{r}LIM^{i}_{\substack{t-10\\t-20}}$	${}^{a}_{r}PInMig^{i}_{\substack{t-10\\t-20}}$	T^i	Pooled
b	-.0006	-.0008	-.002	.006	-.001	.262	.587	.0002	-.038
s	.010	.022	.004	.025	.004	.085	.125	.0003	.010
t	.056	.037	.432	.232	.268	3.08***	4.69***	.797	3.85***

Other data

Intercept

b = .056
s = .030
t = 1.82*

Mean = .189
F = 85.9
N = 87

S.D. = .115
S.S.E. = .037

$R^2 = .91$

Table 5-1 (continued)

Estimated InMigration Functions by State Using Pooled Cross-Section Data

R_2

Period
1955-60
1965-70

White Inmigration 35-39

Ind. Var.	Π_t^i	ΔE_{t-1}^i	TP_{t-5}^i	WD_{t-1}^i	U_{t-1}^i	${}_{r}LIM^{i}_{\substack{t-10\\t-20}}$	${}^{a}_{r}PInMig^{i}_{\substack{t-10\\t-20}}$	T^i	Pooled
b	-.004	-.0009	-.0002	.012	-.001	-.180	1.25	.0003	-.016
s	.010	.022	.004	.024	.004	.177	.235	.0003	.012
t	.406	.040	.04	.483	.304	.988	5.32***	.825	1.25*

Other data

Intercept

b = .023
s = .028
t = .79

Mean = .152
F = 78.63
N = 87

S.D. = .108
S.S.E. = .036

R^2 = .90

White Inmigration 40-49

Ind. Var.	Π_t^i	ΔE_{t-1}^i	TP_{t-5}^i	WD_{t-1}^i	U_{t-1}^i	${}_{r}LIM^{i}_{\substack{t-10\\t-20}}$	${}^{a}_{r}PInMig^{i}_{\substack{t-10\\t-20}}$	T^i	Pooled
b	-.004	-.013	.001	-.005	.0004	-.002	.924	.0003	-.002
s	.007	.015	.003	.016	.002	.117	.185	.0002	.007
t	.537	.90	.418	.340	.162	.013	4.99***	.139	1.15

Other data

Intercept

b = .025
s = .019
t = 1.32*

Mean = .097
F = 73.5
N = 87

S.D. = .070
S.S.E. = .024

R^2 = .90

Table 5-1 (continued)

Estimated InMigration Functions by State Using Pooled Cross-Section Data

R_2

Period
1955-60
1965-70

White Inmigration 50-64

Ind. Var.	Π^i_t	ΔE^i_{t-1}	TP^i_{t-5}	WD^i_{t-1}	U^i_{t-1}	${}_r\mathrm{LIM}^i_{\substack{t-10\\t-20}}$	${}^a_r\mathrm{PInMig}^i_{\substack{t-10\\t-20}}$	T^i	Pooled
b	-.008	-.015	.0005	-.012	.0003	.654	-.053	-.0003	-.024
s	.015	.034	.006	.037	.006	.143	.149	.0005	.013
t	.524	.450	.086	.330	.054	4.58***	.354	.678	1.81**

Other data

Intercept

b = .048
s = .044
t = 1.09

Mean = .067
F = 6.25
N = 87

S.D. = .069
S.S.E. = .056

$R^2 = .42$

Nonwhite Inmigration 15-19

Ind. Var.	Π^i_t	ΔE^i_{t-1}	ADC^i_{t-1}	WD^i_{t-1}	U^i_{t-1}	${}_r\mathrm{LIM}^i_{\substack{t-10\\t-20}}$	${}^a_r\mathrm{PInMig}^i_{\substack{t-10\\t-20}}$	T^i	Pooled
b	-.008	.003	-.015	.011	.002	-.029	.102	.0001	-.139
s	.013	.028	.022	.365	.005	.090	.064	.0005	.011
t	.643	.102	.709	.310	.470	.319	15.8***	.258	.130

Other data

Intercept

b = .015
s = .038
t = .407

Mean = .122
F = 38.7
N = 87

S.D. = .102
S.S.E. = .046

$R^2 = .82$

Table 5-1 (continued)

Estimated InMigration Functions by State Using Pooled Cross-Section Data

R_2

Period
1955-60
1965-70

Nonwhite Inmigration 20-24

Ind. Var.	Π^i_t	ΔE^i_{t-1}	ADC^i_{t-1}	WD^i_{t-1}	U^i_{t-1}	$_rLIM^i_{t-10 \atop t-20}$	$^a_rPInMig^i_{t-10 \atop t-20}$	T^i	Pooled
b	-.021	.023	-.031	.043	.021	-.020	.90	-.0002	-.036
s	.014	.029	.022	.037	.005	.134	.041	.0005	.011
t	1.53*	.791	1.41*	1.17	.447	.151	22.2***	.480	3.40***

Other data

Intercept

b = .049
s = .039
t = 1.29*

Mean = .235
F = 98.00
N = 87

S.D. = .153
S.S.E. = .046

R^2 = .92

Nonwhite Inmigration 25-29

Ind. Var.	Π^i_t	ΔE^i_{t-1}	ADC^i_{t-1}	WD^i_{t-1}	U^i_{t-1}	$_rLIM^i_{t-10 \atop t-20}$	$^a_rPInMig^i_{t-10 \atop t-20}$	T^i	Pooled
b	-.003	.0009	-.030	.042	-.004	-.077	.929	-.0003	-.013
s	.011	.025	.019	.032	.004	.068	.067	.0004	.093
t	.244	.038	1.58*	1.34	.93	1.13	13.96***	.640	1.40*

Other data

Intercept

b = .023
s = .033
t = .710

Mean = .152
F = 39.8
N = 87

S.D. = .090
S.S.E. = .040

R^2 = .82

Table 5-1 (continued)

Estimated InMigration Functions by State Using Pooled Cross-Section Data

R_2

Period
1955-60
1965-70

Nonwhite Inmigration 30-34

Ind. Var.	Π^{i}_{t}	ΔE^{i}_{t-1}	ADC^{i}_{t-1}	WD^{i}_{t-1}	U^{i}_{t-1}	${}_{r}LIM^{i}_{\substack{t-10\\t-20}}$	${}^{a}_{r}PInMig^{i}_{\substack{t-10\\t-20}}$	T^{i}	Pooled
b	.004	.007	-.020	.035	-.003	-.016	.936	-.00008	-.007
s	.010	.021	.015	.025	.003	.028	.053	.0003	.007
t	.446	.359	1.37*	1.37*	.911	.579	17.5***	.237	.933

Other data

Intercept

b = .0002
s = .027
t = .008

Mean = .114
F = 54.8
N = 87

S.D. = .082
S.S.E. = .032

$R^2 = .86$

Nonwhite Inmigration 35-39

Ind. Var.	Π^{i}_{t}	ΔE^{i}_{t-1}	ADC^{i}_{t-1}	WD^{i}_{t-1}	U^{i}_{t-1}	${}_{r}LIM^{i}_{\substack{t-10\\t-20}}$	${}^{a}_{r}PInMig^{i}_{\substack{t-10\\t-20}}$	T^{i}	Pooled
b	.006	.005	-.004	.008	-.001	-.012	.946	-.00006	-.005
s	.007	.002	.01	.020	.003	.045	.065	.0003	.006
t	.080	.294	.332	.394	.395	.272	14.61***	.248	.837

Other data

Intercept

b = .071
s = .021
t = .337

Mean = .093
F = 53.07
N = 87

S.D. = .065
S.S.E. = .026

$R^2 = .86$

Table 5-1 (continued)

Estimated InMigration Functions by State Using Pooled Cross-Section Data

R_2

Period
1955-60
1965-70

Nonwhite Inmigration 40-49

Ind. Var.	Π^i_t	ΔE^i_{t-1}	TP^i_{t-5}	WD^i_{t-1}	U^i_{t-1}	${}_{r}LIM^i_{\substack{t-10\\t-20}}$	${}^{a}_{r}PInMig^i_{\substack{t-10\\t-20}}$	T^i	Pooled
b	.004	.007	.002	-.00005	-.0010	.031	.877	.0001	-.004
s	.005	.011	.0018	.011	.002	.0604	.104	.0002	.004
t	.772	.677	.900	.004	.557	.511	8.40***	.713	.955

Other data

Intercept

b = -.004
s = .013
t = .314

Mean = .061
F = 65.4
N = 87

S.D. = .047
S.S.E. = .017

R^2 = .88

Nonwhite Inmigration 50-64

Ind. Var.	Π^i_t	ΔE^i_{t-1}	TP^i_{t-5}	WD^i_{t-1}	U^i_{t-1}	${}_{r}LIM^i_{\substack{t-10\\t-20}}$	${}^{a}_{r}PInMig^i_{\substack{t-10\\t-20}}$	T^i	Pooled
b	.006	.020	-.0009	.006	-.106	-.061	.819	-.00005	-.011
s	.006	.011	.002	.012	.002	.055	.092	.0002	.004
t	1.02	1.77***	.458	.497	.561	1.13	8.94***	.295	2.50***

Other data

Intercept

b = .00534
s = .015
t = .367

Mean = .035
F = 15.5
N = 87

S.D. = .029
S.S.E. = .018

R^2 = .64

Table 5-2

Estimated OutMigration Functions by State Using Pooled Cross-Section Data

R_2

Period
1955-60
1965-70

White Outmigration 15-19

Ind. Var.	Π^{i}_{t}	ΔE^{i}_{t-1}	TP^{i}_{t-5}	WD^{i}_{t-1}	U^{i}_{t-1}	${}_{r}LOM^{i}_{\substack{t-10\\t-20}}$	${}^{a}_{r}POutMig^{i}_{\substack{t-10\\t-20}}$	T^{i}	Pooled
b	.0013	.024	-.003	.012	.003	.467	.353	.0002	-.05
s	.011	.025	.005	.028	.004	.087	.139	.0004	.011
t	.112	.957	.653	.417	.693	5.38***	2.54***	.479	4.60***

Other data

Intercept

b = .052
s = .034
t = 1.54*

Mean = .14
F = 27.7
N = 87

S.D. = .080
S.S.E. = .041

R^2 = .76

White Outmigration 20-24

Ind. Var.	Π^{i}_{t}	ΔE^{i}_{t-1}	TP^{i}_{t-5}	WD^{i}_{t-1}	U^{i}_{t-1}	${}_{r}LOM^{i}_{\substack{t-10\\t-20}}$	${}^{a}_{r}POutMig^{i}_{\substack{t-10\\t-20}}$	T^{i}	Pooled
b	.031	.0161	-.014	.014	-.014	.558	.183	-.0001	-.018
s	.021	.046	.008	.053	.007	.153	.081	.0007	.019
t	1.53*	.352	1.70**	.262	1.76**	3.64***	2.25**	.194	.934

Other data

Intercept

b = .179
s = .063
t = 2.85***

Mean = .272
F = 7.02
N = 87

S.D. = .096
S.S.E. = .075

R^2 = .45

Table 5-2 (continued)

Estimated OutMigration Functions by State Using Pooled Cross-Section Data

R_2

Period
1955-60
1965-70

White Outmigration 25-29

Ind. Var.	Π^i_t	ΔE^i_{t-1}	TP^i_{t-5}	WD^i_{t-1}	U^i_{t-1}	${}_{r}LOM^{i}_{\substack{t-10\\t-20}}$	${}^{a}_{r}POutMig^{i}_{\substack{t-10\\t-20}}$	T^i	Pooled
b	-.0097	-.0002	.002	-.058	.011	.987	.729	-.0005	-.134
s	.027	.061	.011	.068	.010	.335	.145	.0009	.026
t	.357	.003	.206	.856	1.09	2.94***	5.03***	.518	5.11***

Other data

Intercept

b = .174
s = .081
t = 2.14**

Mean = .292
F = 27.03
N = 87

S.D. = .192
S.S.E. = .100

R^2 = .76

White Outmigration 30-34

Ind. Var.	Π^i_t	ΔE^i_{t-1}	TP^i_{t-5}	WD^i_{t-1}	U^i_{t-1}	${}_{r}LOM^{i}_{\substack{t-10\\t-20}}$	${}^{a}_{r}POutMig^{i}_{\substack{t-10\\t-20}}$	T^i	Pooled
b	-.0003	.007	.004	-.035	.037	-.191	1.23	-.00009	-.032
s	.024	.055	.010	.065	.009	.103	.104	.0008	.023
t	.013	.124	.366	.537	.401	1.85**	11.8***	.111	1.37*

Other data

Intercept

b = .106
s = .076
t = 1.39*

Mean = .208
F = 25.8
N = 87

S.D. = .170
S.S.E. = .089

R^2 = .75

Table 5-2 (continued)

Estimated OutMigration Functions by State Using Pooled Cross-Section Data

R_2

Period
1955-60
1965-70

White Outmigration 35-39

Ind. Var.	Π^i_t	ΔE^i_{t-1}	TP^i_{t-5}	WD^i_{t-1}	U^i_{t-1}	${}_rLOM^i_{\substack{t-10\\t-20}}$	${}^a_rPOutMig^i_{\substack{t-10\\t-20}}$	T^i	Pooled
b	-.006	.011	-.001	-.020	.0028	.163	.872	-.0003	-.062
s	.021	.047	.008	.051	.008	.200	.285	.0007	.022
t	.286	.233	.126	.396	.361	.829	3.06*	.394	2.88**

Other data

Intercept

b = .081
s = .059
t = 1.37*

Mean = .164
F = 21.9
N = 87

S.D. = .136
S.S.E. = .076

R^2 = .72

White Outmigration 40-49

Ind. Var.	Π^i_t	ΔE^i_{t-1}	TP^i_{t-5}	WD^i_{t-1}	U^i_{t-1}	${}_rLOM^i_{\substack{t-10\\t-20}}$	${}^a_rPOutMig^i_{\substack{t-10\\t-20}}$	T^i	Pooled
b	-.004	.007	-.00001	-.020	.005	.355	.504	-.0003	-.032
s	.004	.022	.977	.024	.004	.085	.158	.0003	.009
t	.456	.230	.003	.824	1.29*	4.19***	3.19***	.898	3.57***

Other data

Intercept

b = .051
s = .028
t = 1.81**

Mean = .107
F = 48.9
N = 87

S.D. = .088
S.S.E. = .037

R^2 = .85

Table 5-2 (continued)

Estimated OutMigration Functions by State Using Pooled Cross-Section Data

R_2

Period
1955-60
1965-70

White Outmigration 50-64

Ind. Var.	Π^{i}_{t}	ΔE^{i}_{t-1}	TP^{i}_{t-5}	WD^{i}_{t-1}	U^{i}_{t-1}	${}_{r}LOM^{i}_{\substack{t-10\\t-20}}$	${}^{a}_{r}POutMig^{i}_{\substack{t-10\\t-20}}$	T^{1}	Pooled
b	-.003	.0005	-.0004	.008	-.0001	.782	-.081	-.0009	-.030
s	.017	.038	.007	.042	.006	.125	.131	.0006	.015
t	.181	.013	.060	.194	.020	6.28***	.616	1.56*	1.97**

Other data

Intercept

b = .047
s = .048
t = .885

Mean = .074
F = 6.88
N = 87

S.D. = .079
S.S.E. = .062

R^2 = .44

Nonwhite Outmigration 15-19

Ind. Var.	Π^{i}_{t}	ΔE^{i}_{t-1}	ADC^{i}_{t-1}	WD^{i}_{t-1}	U^{i}_{t-1}	${}_{r}LOM^{i}_{\substack{t-10\\t-20}}$	${}^{a}_{r}POutMig^{i}_{\substack{t-10\\t-20}}$	T^{1}	Pooled
b	.011	-.024	-.019	.033	.0072	.163	.248	.00002	.001
s	.013	.029	.022	.037	.005	.074	.079	.0005	.011
t	.851	.815	.868	.890	1.47*	2.21**	3.12***	.052	.110

Other data

Intercept

b = .041
s = .038
t = 1.07

Mean = .085
F = 4.94
N = 87

S.D. = .055
S.S.E. = .046

R^2 = .36

Table 5-2 (continued)

Estimated OutMigration Functions by State Using Pooled Cross-Section Data

R_2

Period
1955-60
1965-70

Nonwhite Outmigration 20-24

Ind. Var.	Π^{i}_{t}	ΔE^{i}_{t-1}	ADC^{i}_{t-1}	WD^{i}_{t-1}	U^{i}_{t-1}	${}_{r}LOM^{i}_{\substack{t-10\\t-20}}$	${}^{a}_{r}POutMig^{i}_{\substack{t-10\\t-20}}$	T^{i}	Pooled
b	.050	-.051	-.048	.114	-.004	.169	.724	-.0002	-.031
s	.025	.056	.042	.071	.009	.230	.101	.0009	.021
t	2.00**	.913	1.13	1.59*	.401	.734	7.16***	.247	1.46*

Other data

Intercept

b = .016
s = .763
t = .209

Mean = .193
F = 11.17
N = 87

S.D. = .128
S.S.E. = .089

R^2 = .57

Nonwhite Outmigration 25-29

Ind. Var.	Π^{i}_{t}	ΔE^{i}_{t-1}	ADC^{i}_{t-1}	WD^{i}_{t-1}	U^{i}_{t-1}	${}_{r}LOM^{i}_{\substack{t-10\\t-20}}$	${}^{a}_{r}POutMig^{i}_{\substack{t-10\\t-20}}$	T^{i}	Pooled
b	.002	.040	.006	.048	-.001	.324	.746	-.0006	-.033
s	.019	.042	.032	.054	.007	.111	.090	.0007	.017
t	.126	.952	.175	.894	.165	2.92***	8.27***	.871	1.93**

Other data

Intercept

b = .016
s = .057
t = .278

Mean = .194
F = 19.97
N = 87

S.D. = .116
S.S.E. = .067

R^2 = .70

Table 5-2 (continued)

Estimated OutMigration Functions by State Using Pooled Cross-Section Data

R_2

Period
1955-60
1965-70

Nonwhite Outmigration 30-34

Ind. Var.	Π^i_t	ΔE^i_{t-1}	ADC^i_{t-1}	WD^i_{t-1}	U^i_{t-1}	$r^{LOM^i_{t-10}}_{t-20}$	$r^{{}^{a}POutMig^i_{t-10}}_{t-20}$	T^i	Pooled
b	-.012	.046	.004	.028	.001	.012	.654	-.0004	-.009
s	.013	.028	.021	.036	.005	.061	.08	.0005	.011
t	.957	1.63*	.180	.763	.241	.201	8.28***	.843	.871

Other data

Intercept

b = .030
s = .037
t = .797

Mean = .133
F = 18.5
N = 87

S.D. = .075
S.S.E. = .045

R^2 = .68

Nonwhite Outmigration 35-39

Ind. Var.	Π^i_t	ΔE^i_{t-1}	ADC^i_{t-1}	WD^i_{t-1}	U^i_{t-1}	$r^{LOM^i_{t-10}}_{t-20}$	$r^{{}^{a}POutMig^i_{t-10}}_{t-20}$	T^i	Pooled
b	.021	.013	.0169	.043	-.003	.089	.944	-.00002	-.032
s	.016	.036	.028	.047	.006	.101	.115	.0006	.014
t	1.30*	.357	.607	.915	.491	.878	8.18***	.003	2.25**

Other data

Intercept

b = -.041
s = .050
t = .818

Mean = .122
F = 24.7
N = 87

S.D. = .111
S.S.E. = .059

R^2 = .74

Table 5-2 (continued)

Estimated OutMigration Functions by State Using Pooled Cross-Section Data

R_2

Period
1955-60
1965-70

Nonwhite Outmigration 40-49

Ind. Var.	Π^i_t	ΔE^i_{t-1}	TP^i_{t-5}	WD^i_{t-1}	U^i_{t-1}	$r^{LOM^i_{t-10}}_{t-20}$	${}^a_r POutMig^i_{t-10}{}_{t-20}$	T^i	Pooled
b	.010	.050	-.003	.020	-.005	.356	.551	-.0004	-.020
s	.011	.024	.004	.026	.004	.006	.098	.0004	.009
t	.912	1.99**	.593	.788	1.60*	6.31***	5.61***	1.17	2.21**

Other data

Intercept

b = -.014
s = .032
t = .388

Mean = .075
F = 21.0
N = 87

S.D. = .068
S.S.E. = .039

R^2 = .71

Nonwhite Outmigration 50-64

Ind. Var.	Π^i_t	ΔE^i_{t-1}	TP^i_{t-5}	WD^i_{t-1}	U^i_{t-1}	$r^{LOM^i_{t-10}}_{t-20}$	${}^a_r POutMig^i_{t-10}{}_{t-20}$	T^i	Pooled
b	-.004	.017	-.002	-.009	-.004	.142	.365	-.000004	-.02
s	.006	.014	.002	.015	.002	.054	.105	.002	.006
t	.734	1.21	.697	.580	1.53*	2.62***	3.49***	.017	3.44***

Other data

Intercept

b = .029
s = .018
t = 1.60*

Mean = .039
F = 4.78
N = 87

S.D. = .026
S.S.E. = .022

R^2 = .36

for inmigration maintain the high coefficient of determination, the significant F levels, and generally low standard errors. However, the number of independent variables which are significant is lower, most often two, whereas the Table 4-1 functions usually have six variables significant at the ten percent level or better. Generally, the past inmigration variable maintains its high level of significance measured by the t-test, but the change in employment variable loses much of its statistical significance and changes from positive to negative in five of the seven cases. It appears that the removal of the larger states adversely affected much of the theoretical basis of the white inmigration functions.

In contrast, the R_2 nonwhite inmigration functions have a higher coefficient of determination, a greater F-value, and lower standard errors than the functions in Table 4-1. For the most part, past inmigration is highly significant, and may "swamp" the other variables in terms of significance tests, and forecasting. There is little difference in the number and degree of significance of the variables in R_2 and Table 4-1.

The estimated white outmigration functions for R_2 closely resemble the functions estimated in Table 4-2. Although all the coefficients of determination are lower for R_2, most of the independent variables maintain their significance and signs in both functions. The R_2 white outmigration functions usually have four and often more of the independent variables that are statistically significant at around the ten percent level or better.

Finally, the nonwhite outmigration equations for R_2 are consistent with the functions in Table 4-2. Both lagged migration and past migration maintain their significance and sign. However, the A.D.C. variable, which was significant for all the observations in Table 4-2, was not statistically significant in R_2. It possessed the hypothesized negative sign in only two of the five cohorts. In sum, the R_2 fit of the model provides an adequate proxy to the total model so that testing it with a past rates method, which is most commonly used in making migration forecasts, will allow some assessment as to its reliability.

The Test of the R_2 Model

The results of the test of the regression model and past-rates method with actual migration using the U-statistic are presented in Table 5-3.

Table 5-3 compared total inmigration and total outmigration for selected states using alternative methods. In general, both R_2 and past-rates perform well in forecasting over this short time period (i.e., 5 years). In only 13 of the 60 cases the U-statistic is greater than .10 and in no case is it greater than .25. Although both methods perform well, closer examination shows that the R_2 model is the better overall forecasting method.

For inmigration, the R_2 regression method has a lower U-statistic in 10 of the 15 states. In addition, in five of these ten states the U-statistic is twice as high for past-rates as it is for the R_2 regression model. Moreover, no systematic geographic bias can be detected for R_2

Table 5-3

U-statistics for In and Outmigration for Selected States[1]

States	R_2 Regression		Past Rates	
	Inmigration	Outmigration	Inmigration	Outmigration
Alabama	.092090	.095874	.103960	.076529
Arizona	.177830	.119196	.153737	.095867
California	.176964	.245629	.176069	.126750
Connecticut	.030218	.076838	.065681	.097024
Florida	.155248	.127800	.144149	.091454
Illinois	.064618	.053513	.050993	.041737
Indiana	.062178	.072165	.044739	.056539
Kansas	.023408	.071145	.031723	.044229
Kentucky	.038639	.071826	.071213	.083978
Maryland	.037837	.092825	.053395	.042137
Massachusetts	.033999	.094541	.079859	.060885
Michigan	.051802	.131316	.112472	.078079
Oregon	.063132	.076759	.063334	.089299
Virginia	.038612	.046524	.043806	.036179
Wisconsin	.034560	.069614	.067067	.070857

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[1] PL-1 Program for U-Statistic is presented in Appendix C.

by observing these states. These results clearly suggest the more accurate forecasting properties of the R_2 regression method over past-rates for total inmigration.

In contrast, the past-rates method is more accurate with respect to outmigration forecasts. This may be expected since the fit of the regression line is poorer for outmigration than for inmigration, and past migration had a greater tendency to dominate the other variables. For the most part the values of the R_2 outmigration model and past-rates are similar, and in only two cases is the R_2 model's U-statistic twice as high as the past-rates method. These results support the Lowry hypothesis that a constant proportion of any population outmigrates, and that economic factors play a small role.

In sum, a method which takes account of the underlying changes in the structure of the economy over time should be more able to forecast geographic labor mobility. In this case the regression method is capable of detecting positive or negative changes in each flow, which past-rates is unable to do. Finally, the regression model does better than past-rates at avoiding extreme errors. These findings encourage further development of such a model as a technique for forecasting.

Forecasts for Illinois

Table 5-3 shows that values of the R_2 U-statistic for Illinois for in and outmigration are quite low (i.e., below .10). Moreover, for outmigration the U-statistic for R_2 is the second lowest of that category for the 15 states that were examined. Even greater accuracy can be obtained through the use of the complete model which was specified and estimated in Chapter IV, and contained complete data for both time periods. Greater reliability can be assumed since that model had a better fit and greater stability among the signs and the magnitudes of the coefficients than R_2. In order to make migration projections beginning in 1970 for fifteen years hence, some assessment should be made with respect to changes that may occur in the Illinois economy. In order to accomplish this the OBERS demographic and economic projections will be used.

The Economic Projections

In view of the comprehensiveness and detail of the OBERS economic projections, they were decided upon in order to make status quo migration forecasts. The other conditional forecasts were based on more optimistic forecasts of the economy and the third one was based on a pessimistic economic forecast. The OBERS projections were based on long run or secular trends and ignore the cyclical fluctuations which characterize the short run paths of the paths of the economy. The general assumptions that underlie the projections are as follows:

1) Growth of population will be conditioned by a decline of fertility rates from those of the 1962-65 period.
2) Nationally, reasonably full employment represented by a four percent unemployment rate.
3) No foreign conflicts are assumed to occur at the projection dates.
4) Continued technological progress and capital accumulation will support a growth in private output per manhour of three percent annually.

5) New products that will appear will be accommodated, within the existing industrial classification system, and therefore, no new industrial classifications are necessary.
6) Growth in output can be achieved without ecological disaster or serious deterioration.

The regional projections are based on the following additional assumptions:

1) Most factors that have influenced historical shifts in regional "export" industries location will continue into the future with varying degrees of intensity.
2) Trends toward economic area self-sufficiency in local-service industries will continue.
3) Workers will migrate to areas of economic opportunities and away from slow-growth or declining areas.
4) Regional earnings per worker and income per capita will continue to converge toward the national average.
5) Regional employment/population ratios will tend to move toward the national ratio (OBERS, 1972).

The method of implementing the regional forecasts was a variation of "shift-share" analysis with regional share effects calculated implicitly rather than explicitly. A least squares regression line was fitted for income and employment to the logarithm of the percentage shares and the logarithm of time. OBERS' use of the logarithm of percentages converted the data to a ratio scale so the slope of the line expressed the growth rate and the projected rate could be compared to the historic rate by observing the comparative slopes. The logarithm of time was used to dampen the slopes of rapidly rising or falling curves.

Using the OBERS' projections as a benchmark two alternative sets of forecasts were developed and used. The first set (0_1) assumes a more optimistic projection of the economy with lower unemployment and greater growth in employment and productivity than the OBERS suggests. The second set of conditional forecasts (P_1) assumes a pessimistic projection of the economy with higher unemployment and slower growth in employment and productivity than the OBERS projection. The forecasts through the years 1975, 1980, and 1985 for Illinois are iterative so that each period's projections can serve as a basis for the following forecast. The population projection assumes zero net migration, constant life tables based on 1967 levels, no foreign immigration, and are appropriately disaggregated by race and age to permit detailed projections (Redwood, 1972). The results of each forecast are stated in Table 5-4.

A Comparison of the Projections for Illinois

The projections using the alternative economic forecasts provides an interesting contrast. The optimistic and pessimistic forecasts are usually at the extremes and the OBER forecasts provide a middle ground. With respect to geographic mobility the models' results show that optimistic economic conditions result in both greater in and outmigration for Illinois. In contrast, the OBER forecasts show a decline in inmigration and an increase in outmigration while the pessimistic forecasts show a slight increase in inmigration and decline in outmigration with poor economic conditions.

Table 5-4

Projections of Age-Race In and Outmigration 1970-75, 1975-80, 1980-85--Illinois

White	Years 1965-1970[1]		White	Using OBER Forecasts Years 1970-1975	
Age	Inmigration	Outmigration	Age	Inmigration	Outmigration
15-19	64,901	83,745		55,888	82,542
20-24	106,803	139,398		103,530	135,380
25-29	104,065	103,415		105,920	118,040
30-34	58,692	71,511		53,882	80,284
35-39	42,261	53,694		41,416	55,394
40-49	57,784	78,639		56,094	85,309
50-64	36,646	75,856		33,396	71,346

Nonwhite	Years 1965-1970[1]		Nonwhite	Using OBER Forecasts Years 1970-1975	
Age	Inmigration	Outmigration	Age	Inmigration	Outmigration
15-19	8,551	6,286		8,924	9,831
20-24	15,578	9,680		20,344	12,326
25-29	9,763	7,271		13,672	11,594
30-34	5,190	4,510		7,127	8,591
35-39	3,319	3,406		4,631	3,359
40-49	4,355	4,478		4,848	3,556
50-64	3,122	3,622		2,786	2,322

[1] Actual Migration

Table 5-4 (continued)

White	Using O_1 Forecasts Years 1970-1975		White	Using P_1 Forecasts Years 1970-1975	
Age	Inmigration	Outmigration	Age	Inmigration	Outmigration
15-19	61,047	85,981		47,290	80,822
20-24	106,420	129,590		101,360	138,280
25-29	105,280	132,070		110,380	97,621
30-34	52,804	90,521		58,192	65,736
35-39	40,899	65,231		44,005	42,452
40-49	53,757	96,996		64,274	71,286
50-64	28,842	80,454		45,540	65,274

Nonwhite	Using O_1 Forecasts Years 1970-1975		Nonwhite	Using P_1 Forecasts Years 1970-1975	
Age	Inmigration	Outmigration	Age	Inmigration	Outmigration
15-19	9,226	10,285		8,470	8,924
20-24	21,062	13,643		19,267	8,018
25-29	14,766	11,047		12,031	12,141
30-34	7,712	9,177		6,248	7,517
35-39	4,903	3,450		4,086	2,996
40-49	5,010	3,717		4,364	3,556
50-64	3,405	2,476		2,012	2,167

Table 5-4 (continued)

White	Using OBER Forecasts Years 1975-1980		White	Using O_1 Forecasts Years 1975-1980	
Age	Inmigration	Outmigration	Age	Inmigration	Outmigration
15-19	50,378	87,933		60,567	100,030
20-24	107,820	155,550		115,630	156,390
25-29	113,920	135,850		111,560	162,140
30-34	55,921	100,900		54,283	124,080
35-39	40,759	58,525		38,775	75,509
40-49	46,002	83,639		43,904	107,080
50-64	32,647	77,730		25,551	94,689

Nonwhite	Using OBER Forecasts Years 1975-1980		Nonwhite	Using O_1 Forecasts Years 1975-1980	
Age	Inmigration	Outmigration	Age	Inmigration	Outmigration
15-19	9,938	12,751		10,679	13,490
20-24	28,279	16,272		30,061	19,044
25-29	16,805	15,604		19,224	14,844
30-34	8,591	11,560		9,757	12,727
35-39	5,702	3,093		6,294	3,292
40-49	4,969	4,969		5,483	5,483
50-64	2,766	1,729		3,813	1,907

Table 5-4 (continued)

White Age	Using P_1 Forecasts Years 1975-1980		Nonwhite Age	Using P_1 Forecasts Years 1975-1980	
	Inmigration	Outmigration		Inmigration	Outmigration
15-19	35,454	75,454		8,834	11,278
20-24	100,630	151,360		26,278	7,416
25-29	123,780	100,340		13,199	16,145
30-34	62,669	68,309		6,800	9,669
35-39	47,175	34,309		4,534	2,315
40-49	59,791	56,588		4,100	4,271
50-64	51,903	61,340		1,206	1,550

Table 5-4 (continued)

White	Using OBER Forecasts Years 1980-1985		White	Using O_1 Forecasts Years 1980-1985	
Age	Inmigration	Outmigration	Age	Inmigration	Outmigration
15-19	39,078	86,840		51,990	106,580
20-24	107,650	171,710		120,150	176,640
25-29	133,320	154,850		131,100	200,650
30-34	60,337	117,990		58,749	157,520
35-39	48,303	67,868		45,619	97,163
40-49	44,625	84,291		40,577	114,970
50-64	37,102	86,570		31,959	114,140

Nonwhite	Using OBER Forecasts Years 1980-1985		Nonwhite	Using O_1 Forecasts Years 1980-1985	
Age	Inmigration	Outmigration	Age	Inmigration	Outmigration
15-19	8,294	11,980		9,400	12,349
20-24	36,780	16,303		39,960	19,782
25-29	21,648	21,943		26,029	20,763
30-34	9,491	13,333		11,299	14,802
35-39	6,782	2,799		7,887	3,133
40-49	4,765	7,059		5,648	8,295
50-64	2,320	1,740		3,884	2,136

Table 5-4 (continued)

White Age	Using P_1 Forecasts Years 1980-1985		Nonwhite Age	Using P_1 Forecasts Years 1980-1985	
	Inmigration	Outmigration		Inmigration	Outmigration
15-19	19,917	61,483		6,648	10,526
20-24	93,101	161,370		32,907	3,208
25-29	145,860	88,217		15,595	23,392
30-34	67,426	58,199		6,672	10,631
35-39	60,884	25,424		4,934	1,609
40-49	59,884	40,268		3,526	5,466
50-64	58,517	50,609		1,920	1,344

Overall, the model suggests a continued net outmigration of whites for all ages. This is especially true for the older white age groups. However, better economic conditions tends to attract younger whites, and if growth is greater than the OBER anticipates the state could minimize the net outflow.

The model for nonwhite migration supports the hypothesis that the large net inmigration to Illinois is over. Each set of projections show a positive but small net inmigration to the state. Within the context of this forecasting model, nonwhites appear to be more responsive to economic incentives than whites. For most groups and in two of the three forecast periods better economic conditions results in greater inmigration and smaller outmigration for nonwhites.

Since estimates of future population in as much age and color detail as possible are urgently required at the state level for the planning of future state services, housing and transportation needs, as well as in the planning of economic development, education delivery systems, and human resource utilization, these projections can have many policy implications. For example, the Illinois Board of Higher Education is currently considering expanding its junior colleges and secondary higher education facilities, based on high fertility, and positive net migration of persons of college age. Recent trends in fertility, and the results presented in this chapter suggest that these assumptions by the Board are open to considerable question, and should at least be reexamined in order to avoid considerable excess capacity in higher education.

One major advantage in the approach presented in the last two chapters will be immediately apparent. The effects of population growth and structure change on the economy have long been recognized, but the reverse, the flow of socio-economic influences on population, has only recently become the subject of theoretical and empirical analysis. A two-way relationship exists, and the incorporation of socio-economic variables into a migration projection model therefore provides scope ultimately for this interdependence to be accounted for in a fully developed population forecasting system.

CHAPTER VI

AN ANALYSIS OF INTERSTATE OCCUPATIONAL MIGRATION

Purpose and Theoretical Backdrop

The study of factors that influence the in and outmigration of persons of different occupations has received some theoretical attention but almost no empirical testing. This chapter will review the existing theory, and develop a model to analyze interstate occupational mobility by aggregated age groups using data from the one-in-a-hundred public use sample--five percent state sample. This study will primarily be concerned with the economic factors that influence the directional flows of migrants by states. Through utilizing this analysis, qualitative conclusions can be discussed with regard to the occupational composition of migration flows.

In order to apply a previous theoretical discussion to occupational mobility (see Chapter III), one may assume that persons of a given occupation may migrate to increase the present value of the expected stream of benefits resulting from their occupation. These benefits include lifetime earnings and nonmonetary returns. The opportunity to increase these benefits is present if occupations in various states differ in income, growth of the related industry, educational requirements, hours worked, or colleagues present. Since occupational wages are generally determined in a competitive market, wage differences among states may not persist through time. A person within an occupation, utilizing a benefit-cost framework, will presumably migrate when his expected returns from migration exceeds his costs.

An examination of the occupational composition of migrants assumes that persons in certain occupations for which there is a national rather than a local labor market have a higher propensity to migrate. Cross-classified data concerning vital characteristics of migrants, such as age and occupation, are a prerequisite to a thorough study of returns to migration. Although some empirical work has been attempted to relate in and outmigration by occupation for other countries, the lack of data, thus far, has precluded this analysis for the U.S. (Stone, 1971).

This analysis will show that interstate migration by occupation can be related to relative supply and demand features of a state. Therefore, it can be argued that outmigration from a state is determined by relative characteristics within the state. However, the distribution of outmigration may be determined by relative conditions in other states. Although this model ignores distance, it does consider the absolute flows for a state.

The basic model to be used to test the relative merits of economic opportunity and migration flows is an adaptation of the Blanco prospective unemployment net migration model to in and outmigration data (Blanco, 1964). The basic assumption of this model is that the supply of labor in all regions is perfectly elastic, so that any causal relationship between migration and employment changes goes from economic opportunity change to migration rather than the reverse (Renshaw, 1974).

Data Source

The data to be used to obtain in and outmigration by occupation and age is the public use samples of basic records from the 1970 census. Each 1970 public use sample is a representative sample of the records from the 1970 census sample questionnaires. The sample size used is one-in-a-hundred, or one sample unit for every hundred such units in the population. The state public use samples that are to be used are obtained from the five-percent data used in the 1970 Census of Population and Housing. Because the one-in-a-hundred sample size represents a fraction of the total population, each one-in-a-hundred sample actually contains one-fifth of all five-percent basic records, representing slightly over two million persons.

Although greater occupational disaggregation is obtainable with this data source, the occupational groups to be examined will include: professional technical and kindred workers; managers and administrators; sales workers; clerical and kindred workers; operatives, except transport, transport equipment operatives; laborers, except farm; service workers; and private household workers. These large occupational groups were decided upon to allow for sufficient observations and for standardization in relating to these groups in each state for that category. The definitions of these occupations are the ones used by the Department of Commerce, 1970 Census of Population, occupation classification. The age disaggregation will include those between 14 to 24, 25 to 34, and 35 to 64. The first two age classifications will reflect the most highly mobile groups within society. An example of the output of the data for the state of Illinois for all workers is presented in Table 6-1.

Table 6-1

Occupational Migration for Illinois

```
STATE: ILLINOIS
OCCUPATION: PROFESSIONAL,_TECHNICAL,_AND_KINDRED_WORKERS

TOTAL INCLUDED:    6130
PERCENT OCCUPATION EXCLUDED:    3
TOTAL INCOME(1969): 10346                         STATE/NATIONAL:    1.04
HIGHEST GRADE ATTENDED: 17                        STATE/NATIONAL:    0.99
HOURS WORKED: 38                                  STATE/NATIONAL:    0.97
PERCENT BORN OUT OF STATE:  39                    STATE/NATIONAL:    0.84
INCOME FROM PUBLIC ASSISTANCE:    1261            STATE/NATIONAL:    1.30    PERCENT REC.:    0  STATE/NATIONAL:    0.00
RATIO OF INCOME TO POV. CUTOFF:    2.76           STATE/NATIONAL:    1.01

             IMMIGRATION

             AGE         MALE      FEMALE      TOTAL      WHITE     NONWHITE     TOTAL    PCT__IN
             14-24          66         92        158        145         13        158          3
             25-34         334        141        475        427         48        475         11
             35-64         164         76        240        225         15        240          5
             65-             3          3          6          6          0          6          0
             TOTAL         567        312        879        803         76        879         21

             OUTMIGRATION

             AGE         MALE      FEMALE      TOTAL      WHITE     NONWHITE     TOTAL    PCT_OUT
             14-24          76         79        155        147          8        155          3
             25-34         286        128        414        400         14        414         10
             35-64         185         87        272        256         16        272          6
             65-            10          4         14         12          2         14          0
             TOTAL         557        298        855        815         40        855         21
OCCUPATION: MANAGERS_AND_ADMINISTRATORS,_EXCEPT_FARM

TOTAL INCLUDED:    3199
PERCENT OCCUPATION EXCLUDED:    1
TOTAL INCOME(1969): 13998                         STATE/NATIONAL:    1.13
HIGHEST GRADE ATTENDED: 15                        STATE/NATIONAL:    1.00
HOURS WORKED: 44                                  STATE/NATIONAL:    0.98
PERCENT BORN OUT OF STATE:  34                    STATE/NATIONAL:    0.80
INCOME FROM PUBLIC ASSISTANCE:    905             STATE/NATIONAL:    0.97    PERCENT REC.:    0  STATE/NATIONAL:    0.00
RATIO OF INCOME TO POV. CUTOFF:    2.79           STATE/NATIONAL:    1.02

             IMMIGRATION

             AGE         MALE      FEMALE      TOTAL      WHITE     NONWHITE     TOTAL    PCT__IN
             14-24          19          7         26         25          1         26          1
             25-34          83          9         92         89          3         92          3
             35-64         147         17        164        158          6        164          6
             65-             0          2          2          2          0          2          0
             TOTAL         249         35        284        274         10        284         11

             OUTMIGRATION

             AGE         MALE      FEMALE      TOTAL      WHITE     NONWHITE     TOTAL    PCT_OUT
             14-24          16          4         20         19          1         20          0
             25-34          91          9        100         99          1        100          3
             35-64         198         21        219        216          3        219          8
             65-             5          0          5          5          0          5          0
             TOTAL         310         34        344        339          5        344         13
```

Table 6-1 (continued)

```
OCCUPATION: SALES_WORKERS

TOTAL INCLUDED:   3143
PERCENT OCCUPATION EXCLUDED:   3
TOTAL INCOME(1969):  8027                     STATE/NATIONAL:   1.14
HIGHEST GRADE ATTENDED: 14                    STATE/NATIONAL:   0.99
HOURS WORKED: 36                              STATE/NATIONAL:   0.97
PERCENT BORN OUT OF STATE:  30                STATE/NATIONAL:   0.80
INCOME FROM PUBLIC ASSISTANCE:    887         STATE/NATIONAL:   0.91    PERCENT REC.:   0  STATE/NATIONAL:   0.00
RATIO OF INCOME TO POV. CUTOFF:   2.68        STATE/NATIONAL:   1.03

            INMIGRATION

            AGE          MALE       FEMALE      TOTAL      WHITE      NONWHITE    TOTAL    PCT__IN
            14-24          33           25         58         52             6       58          2
            25-34          61           15         76         73             3       76          3
            35-64          74           20         94         92             2       94          4
            65-             2            0          2          2             0        2          0
            TOTAL         170           60        230        219            11      230         10

            OUTMIGRATION

            AGE          MALE       FEMALE      TOTAL      WHITE      NONWHITE    TOTAL    PCT_OUT
            14-24          39           29         68         68             0       68          3
            25-34          85           20        105        103             2      105          4
            35-64          79           30        109        106             3      109          4
            65-             9            2         11         11             0       11          0
            TOTAL         212           81        293        288             5      293         13
OCCUPATION: CLERICAL_AND_KINDRED_WORKERS

TOTAL INCLUDED:   8898
PERCENT OCCUPATION EXCLUDED:   2
TOTAL INCOME(1969):  5170                     STATE/NATIONAL:   1.03
HIGHEST GRADE ATTENDED: 14                    STATE/NATIONAL:   0.98
HOURS WORKED: 35                              STATE/NATIONAL:   0.95
PERCENT BORN OUT OF STATE:  28                STATE/NATIONAL:   0.81
INCOME FROM PUBLIC ASSISTANCE:   1025         STATE/NATIONAL:   1.00    PERCENT REC.:   0  STATE/NATIONAL:   0.00
RATIO OF INCOME TO POV. CUTOFF:   2.69        STATE/NATIONAL:   1.02

            INMIGRATION

            AGE          MALE       FEMALE      TOTAL      WHITE      NONWHITE    TOTAL    PCT__IN
            14-24          54          200        254        215            39      254          4
            25-34          66           98        164        145            19      164          3
            35-64          44          100        144        132            12      144          2
            65-             2            0          2          2             0        2          0
            TOTAL         166          398        564        494            70      564         10

            OUTMIGRATION

            AGE          MALE       FEMALE      TOTAL      WHITE      NONWHITE    TOTAL    PCT_OUT
            14-24          25          159        184        170            14      184          3
            25-34          56          122        178        159            19      178          3
            35-64          52          136        188        176            12      188          3
            65-             4            2          6          6             0        6          0
            TOTAL         137          419        556        511            45      556         10
```

Table 6-1 (continued)

```
OCCUPATION: CRAFTSMEN_AND_KINDRED_WORKERS

TOTAL INCLUDED:   6140
PERCENT OCCUPATION EXCLUDED:   2
TOTAL INCOME(1969):  9330                          STATE/NATIONAL:   1.14
HIGHEST GRADE ATTENDED: 12                         STATE/NATIONAL:   0.94
HOURS WORKED: 41                                   STATE/NATIONAL:   0.99
PERCENT BORN OUT OF STATE:  33                     STATE/NATIONAL:   0.95
INCOME FROM PUBLIC ASSISTANCE:     836             STATE/NATIONAL:   1.01    PERCENT REC.:   0  STATE/NATIONAL:    0.00
RATIO OF INCOME TO POV. CUTOFF:    2.67            STATE/NATIONAL:   1.05

              INMIGRATION

              AGE          MALE       FEMALE      TOTAL      WHITE      NONWHITE     TOTAL    PCT__IN
              14-24          69            4         73         60            13        73          1
              25-34         126            7        133        123            10       133          2
              35-64         105            7        112        105             7       112          2
              65-             0            1          1          1             0         1          0
              TOTAL         300           19        319        289            30       319          6

              OUTMIGRATION

              AGE          MALE       FEMALE      TOTAL      WHITE      NONWHITE     TOTAL    PCT_OUT
              14-24          42            5         47         45             2        47          0
              25-34         117            5        122        121             1       122          2
              35-64         138            7        145        129            16       145          2
              65-             3            0          3          3             0         3          0
              TOTAL         300       .   17        317        298            19       317          6
OCCUPATION: OPERATIVES,_EXCEPT_TRANSPORT

TOTAL INCLUDED:   6623
PERCENT OCCUPATION EXCLUDED:   3
TOTAL INCOME(1969):  5971                          STATE/NATIONAL:   1.11
HIGHEST GRADE ATTENDED: 12                         STATE/NATIONAL:   0.99
HOURS WORKED: 38                                   STATE/NATIONAL:   0.97
PERCENT BORN OUT OF STATE:  42                     STATE/NATIONAL:   1.24
INCOME FROM PUBLIC ASSISTANCE:     947             STATE/NATIONAL:   1.01    PERCENT REC.:   1  STATE/NATIONAL:    0.68
RATIO OF INCOME TO POV. CUTOFF:    2.51            STATE/NATIONAL:   1.05

              INMIGRATION

              AGE          MALE       FEMALE      TOTAL      WHITE      NONWHITE     TOTAL    PCT__IN
              14-24         125           79        204        162            42       204          4
              25-34         151           43        194        163            31       194          4
              35-64          97           69        166        148            18       166          3
              65-             3            2          5          5             0         5          0
              TOTAL         376          193        569        478            91       569         12

              OUTMIGRATION

              AGE          MALE       FEMALE      TOTAL      WHITE      NONWHITE     TOTAL    PCT_OUT
              14-24          67           23         90         79            11        90          1
              25-34          68           25         93         75            18        93          2
              35-64          67           40        107         91            16       107          2
              65-             4            1          5          5             0         5          0
              TOTAL         206           89        295        250            45       295          6
```

Table 6-1 (continued)

```
OCCUPATION: TRANSPORT_EQUIPMENT_OPERATIVES

TOTAL INCLUDED:   1747
PERCENT OCCUPATION EXCLUDED:   3
TOTAL INCOME(1969):  7899                   STATE/NATIONAL:   1.15
HIGHEST GRADE ATTENDED: 12                  STATE/NATIONAL:   0.98
HOURS WORKED: 41                            STATE/NATIONAL:   0.98
PERCENT BORN OUT OF STATE:  30              STATE/NATIONAL:   1.00
INCOME FROM PUBLIC ASSISTANCE:    926       STATE/NATIONAL:   1.15    PERCENT REC.:   1  STATE/NATIONAL:   0.92
RATIO OF INCOME TO POV. CUTOFF:   2.54      STATE/NATIONAL:   1.07

              IMMIGRATION

              AGE         MALE        FEMALE      TOTAL       WHITE      NONWHITE     TOTAL    PCT__IN
              14-24         20             0         20          17             3        20          1
              25-34         44             1         45          41             4        45          3
              35-64         20             1         21          19             2        21          1
              65-            0             0          0           0             0         0          0
              TOTAL         84             2         86          77             9        86          6

              OUTMIGRATION

              AGE         MALE        FEMALE      TOTAL       WHITE      NONWHITE     TOTAL    PCT_OUT
              14-24         17             1         18          16             2        18          1
              25-34         36             1         37          32             5        37          2
              35-64         34             1         35          30             5        35          2
              65-            0             1          1           1             0         1          0
              TOTAL         87             4         91          79            12        91          6
OCCUPATION: LABORERS,_EXCEPT_FARM

TOTAL INCLUDED:   2002
PERCENT OCCUPATION EXCLUDED:   4
TOTAL INCOME(1969):  5130                   STATE/NATIONAL:   1.13
HIGHEST GRADE ATTENDED: 12                  STATE/NATIONAL:   1.01
HOURS WORKED: 34                            STATE/NATIONAL:   0.95
PERCENT BORN OUT OF STATE:  33              STATE/NATIONAL:   1.09
INCOME FROM PUBLIC ASSISTANCE:   1027       STATE/NATIONAL:   1.23    PERCENT REC.:   0  STATE/NATIONAL:   0.00
RATIO OF INCOME TO POV. CUTOFF:   2.46      STATE/NATIONAL:   1.11

              IMMIGRATION

              AGE         MALE        FEMALE      TOTAL       WHITE      NONWHITE     TOTAL    PCT__IN
              14-24         50             6         56          48             8        56          4
              25-34         40             3         43          33            10        43          3
              35-64         29             5         34          26             8        34          2
              65-            1             0          1           1             0         1          0
              TOTAL        120            14        134         108            26       134         10

              OUTMIGRATION

              AGE         MALE        FEMALE      TOTAL       WHITE      NONWHITE     TOTAL    PCT_OUT
              14-24         30             5         35          31             4        35          2
              25-34         25             2         27          24             3        27          2
              35-64         31             4         35          30             5        35          2
              65-            2             0          2           2             0         2          0
              TOTAL         88            11         99          87            12        99          7
```

Table 6-1 (continued)

```
OCCUPATION: FARMERS_AND_FARM_MANAGERS

TOTAL INCLUDED:     794
PERCENT OCCUPATION EXCLUDED:    1
TOTAL INCOME(1969):   7593                    STATE/NATIONAL:   1.17
HIGHEST GRADE ATTENDED: 12                    STATE/NATIONAL:   0.99
HOURS WORKED: 46                              STATE/NATIONAL:   0.96
PERCENT BORN OUT OF STATE:   8                STATE/NATIONAL:   0.54
INCOME FROM PUBLIC ASSISTANCE:    1050        STATE/NATIONAL:   1.28    PERCENT REC.:    0  STATE/NATIONAL:   0.00
RATIO OF INCOME TO POV. CUTOFF:   2.32        STATE/NATIONAL:   1.10

            INMIGRATION

            AGE        MALE       FEMALE      TOTAL      WHITE      NONWHITE    TOTAL    PCT__IN
            14-24          0          0          0          0          0          0          0
            25-34          5          0          5          5          0          5          0
            35-64          3          1          4          4          0          4          0
            65-            1          0          1          1          0          1          0
            TOTAL          9          1         10         10          0         10          1

            OUTMIGRATION

            AGE        MALE       FEMALE      TOTAL      WHITE      NONWHITE    TOTAL    PCT_OUT
            14-24          0          0          0          0          0          0          0
            25-34          3          0          3          3          0          3          0
            35-64         10          0         10         10          0         10          1
            65-            0          0          0          0          0          0          0
            TOTAL         13          0         13         13          0         13          1
OCCUPATION: FARM_LABORERS_AND_FARM_FOREMEN

TOTAL INCLUDED:     287
PERCENT OCCUPATION EXCLUDED:    3
TOTAL INCOME(1969):   3415                    STATE/NATIONAL:   1.29
HIGHEST GRADE ATTENDED: 11                    STATE/NATIONAL:   1.05
HOURS WORKED: 38                              STATE/NATIONAL:   1.00
PERCENT BORN OUT OF STATE:  20                STATE/NATIONAL:   0.69
INCOME FROM PUBLIC ASSISTANCE:    1183        STATE/NATIONAL:   1.35    PERCENT REC.:    1  STATE/NATIONAL:   0.38
RATIO OF INCOME TO POV. CUTOFF:   1.98        STATE/NATIONAL:   1.20

            INMIGRATION

            AGE        MALE       FEMALE      TOTAL      WHITE      NONWHITE    TOTAL    PCT__IN
            14-24          4          1          5          3          2          5          2
            25-34          5          1          6          6          0          6          3
            35-64         10          1         11         11          0         11          5
            65-            0          0          0          0          0          0          0
            TOTAL         19          3         22         20          2         22         11

            OUTMIGRATION

            AGE        MALE       FEMALE      TOTAL      WHITE      NONWHITE    TOTAL    PCT_OUT
            14-24          9          1         10         10          0         10          5
            25-34          3          2          5          4          1          5          2
            35-64         10          1         11         10          1         11          5
            65-            2          0          2          2          0          2          1
            TOTAL         24          4         28         26          2         28         14
```

Table 6-1 (continued)

```
OCCUPATION: SERVICE_WORKERS,_EXC._PRIVATE_HOUSEHOLD

TOTAL INCLUDED:    4853
PERCENT OCCUPATION EXCLUDED:    4
TOTAL INCOME(1969):   4226                    STATE/NATIONAL:   1.10
HIGHEST GRADE ATTENDED: 12                    STATE/NATIONAL:   0.96
HOURS WORKED: 34                              STATE/NATIONAL:   0.96
PERCENT BORN OUT OF STATE:  35                STATE/NATIONAL:   0.96
INCOME FROM PUBLIC ASSISTANCE:   1166         STATE/NATIONAL:   1.07    PERCENT REC.:   1  STATE/NATIONAL:   0.46
RATIO OF INCOME TO POV. CUTOFF:   2.38        STATE/NATIONAL:   1.05

              IMMIGRATION

              AGE          MALE        FEMALE       TOTAL       WHITE        NONWHITE     TOTAL    PCT__IN
              14-24          50            78         128         114           14          128          4
              25-34          51            53         104          81           23          104          3
              35-64          44            48          92          80           12           92          3
              65-             0             2           2           2            0            2          0
              TOTAL         145           181         326         277           49          326         11

              OUTMIGRATION

              AGE          MALE        FEMALE       TOTAL       WHITE        NONWHITE     TOTAL    PCT_OUT
              14-24          48            67         115         107            8          115          4
              25-34          17            36          53          40           13           53          1
              35-64          46            66         112          96           16          112          4
              65-             4             1           5           5            0            5          0
              TOTAL         115           170         285         248           37          285         10
OCCUPATION: PRIVATE_HOUSEHOLD_WORKERS

TOTAL INCLUDED:     382
PERCENT OCCUPATION EXCLUDED:    5
TOTAL INCOME(1969):   1578                    STATE/NATIONAL:   1.09
HIGHEST GRADE ATTENDED: 10                    STATE/NATIONAL:   0.92
HOURS WORKED: 25                              STATE/NATIONAL:   0.91
PERCENT BORN OUT OF STATE:  44                STATE/NATIONAL:   1.28
INCOME FROM PUBLIC ASSISTANCE:   1050         STATE/NATIONAL:   1.02    PERCENT REC.:   3  STATE/NATIONAL:   0.54
RATIO OF INCOME TO POV. CUTOFF:   1.87        STATE/NATIONAL:   1.16

              IMMIGRATION

              AGE          MALE        FEMALE       TOTAL       WHITE        NONWHITE     TOTAL    PCT__IN
              14-24           0             7           7           4            3            7          3
              25-34           0             4           4           2            2            4          1
              35-64           0             5           5           1            4            5          2
              65-             0             0           0           0            0            0          0
              TOTAL           0            16          16           7            9           16          7

              OUTMIGRATION

              AGE          MALE        FEMALE       TOTAL       WHITE        NONWHITE     TOTAL    PCT_OUT
              14-24           0            11          11          11            0           11          4
              25-34           0             6           6           6            0            6          2
              35-64           0             9           9           6            3            9          4
              65-             0             2           2           2            0            2          0
              TOTAL           0            28          28          25            3           28         12
```

Table 6-1 (continued)

```
STATE: ILLINOIS____________

INDUSTRY: AGRICULTURE, FORESTRY, AND FISHERIES
CHANGE IN EMPLOYMENT 1965-1970:      118
PERCENT CHANGE IN EMPLOYMENT 1965-1970:  10

INDUSTRY: MINING AND CONSTRUCTION
CHANGE IN EMPLOYMENT 1965-1970:      316
PERCENT CHANGE IN EMPLOYMENT 1965-1970:  14

INDUSTRY: MANUFACTURING, TRANSPORTATION, COMMUNICATIONS, AND OTHER PUBLIC UTILITIES
CHANGE IN EMPLOYMENT 1965-1970:     3773
PERCENT CHANGE IN EMPLOYMENT 1965-1970:  28

INDUSTRY: WHOLESALE AND RETAIL TRADE
CHANGE IN EMPLOYMENT 1965-1970:     3666
PERCENT CHANGE IN EMPLOYMENT 1965-1970:  48

INDUSTRY: FINANCE, INSURANCE, AND REAL ESTATE
CHANGE IN EMPLOYMENT 1965-1970:     1067
PERCENT CHANGE IN EMPLOYMENT 1965-1970:  45

INDUSTRY: BUSINESS, REPAIR, PERSONAL, ENTERTAINMENT AND RECREATIONAL, AND PROFESSIONAL AND RELATED SERVICES
CHANGE IN EMPLOYMENT 1965-1970:     2740
PERCENT CHANGE IN EMPLOYMENT 1965-1970:  64

INDUSTRY: PUBLIC ADMINISTRATION
CHANGE IN EMPLOYMENT 1965-1970:      519
PERCENT CHANGE IN EMPLOYMENT 1965-1970:  35

STATE: INDIANA_____________

INDUSTRY: AGRICULTURE, FORESTRY, AND FISHERIES
CHANGE IN EMPLOYMENT 1965-1970:       26
PERCENT CHANGE IN EMPLOYMENT 1965-1970:   4

INDUSTRY: MINING AND CONSTRUCTION
CHANGE IN EMPLOYMENT 1965-1970:      190
PERCENT CHANGE IN EMPLOYMENT 1965-1970:  18

INDUSTRY: MANUFACTURING, TRANSPORTATION, COMMUNICATIONS, AND OTHER PUBLIC UTILITIES
CHANGE IN EMPLOYMENT 1965-1970:     2122
PERCENT CHANGE IN EMPLOYMENT 1965-1970:  32

INDUSTRY: WHOLESALE AND RETAIL TRADE
CHANGE IN EMPLOYMENT 1965-1970:     1613
PERCENT CHANGE IN EMPLOYMENT 1965-1970:  50

INDUSTRY: FINANCE, INSURANCE, AND REAL ESTATE
CHANGE IN EMPLOYMENT 1965-1970:      450
PERCENT CHANGE IN EMPLOYMENT 1965-1970:  49

INDUSTRY: BUSINESS, REPAIR, PERSONAL, ENTERTAINMENT AND RECREATIONAL, AND PROFESSIONAL AND RELATED SERVICES
CHANGE IN EMPLOYMENT 1965-1970:     1254
PERCENT CHANGE IN EMPLOYMENT 1965-1970:  69

INDUSTRY: PUBLIC ADMINISTRATION
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The Models: Specification

While a number of relationships were fitted for the age groups discussed, the basic relationships in terms of which model specification is discussed are:

$$ {}_{o}\mathrm{InMig}^{i}_{a} = f\ ({}_{o}Y^{r},\ \Delta_{o}E^{i},\ {}_{o}H^{r},\ {}_{o}L^{r},\ {}_{o}M^{r}) $$

$$ {}_{o}\mathrm{OutMig}^{i}_{a} = f\ ({}_{o}Y^{r},\ \Delta_{o}E^{i},\ {}_{o}H^{r},\ {}_{o}L^{r},\ {}_{o}M^{r}) $$

and ${}_{o}\mathrm{InMig}^{i}_{a}$ = number of persons of a (the designated age group) in o (the designated occupation) who resided elsewhere on April 1, 1965, and in i (the state in question) on April 1, 1970 divided by the number of persons in that age group in that occupation in 1965. ${}_{o}\mathrm{OutMig}^{i}_{a}$ = number of persons of a (the designated age group) in o (the designated occupation) who resided in i (the state in question) on April 1, 1965, and elsewhere on April 1, 1970 divided by the number of persons in that age group in that occupation in 1965; ${}_{o}Y^{r}$ is the mean income in that state for occupation o relative to the mean U.S. total income for that occupation; $\Delta_{o}E^{i}$ is the percent change in employment in those industries most closely related to the occupation; ${}_{o}H^{r}$ is the mean weekly number of hours worked in the U.S. for that occupation; ${}_{o}L^{r}$ is the mean educational level measured by highest grade attended in that state for occupation o relative to the mean educational level in the U.S. for that occupation; ${}_{o}M^{r}$ is the migrant stock variable denoting the percent of persons in that occupation (o) in that state who were born in another state relative to the national migrant stock mean for that occupation.

It seems plausible that as the income differential for a particular occupation is high that this would attract inmigrants but would also have a dampening effect on outmigration. The data operationalized for this variable will be the public use sample for total income in 1969, and therefore will reflect somewhat of a lag between income and migration (see Chapter III). The sign associated with ${}_{o}Y^{r}$ should be positive in the inmigration equations and negative in the outmigration equations.

It is generally expected that states in which job opportunities are expanding rapidly will, ceteris paribus, prove desirable destinations for inmigrants (Greenwood, 1973). Therefore, the greater the percentage increase in employment of a related industry in a state, the higher the expected inmigration rate, and the lower the expected outmigration rate. However, it must be stated that it is difficult to account for the interaction of migration and employment without specifying a simultaneous equation model, which is beyond the scope of this study. Although it should be recognized that most migration models, including this one, specify the relationship going from job opportunities to migration (Raimon, 1962; Greenwood, 1973).

The number of weekly hours worked in an occupation in a state is likely to reflect the demand with respect to supply for that occupation in the state. States with low relative number of hours worked for an occupation are not likely to be desirable destinations for migrants of that line of work. Furthermore, states characterized by low relative number of hours worked are more likely to have persons who are actively in search of new jobs in other labor markets. Therefore, ceteris paribus, the higher a state's relative number of hours worked, the higher its expected rate of inmigration, and the lower its expected rate of outmigration.

There has been considerable discussion concerning the effect of education on increasing mobility. By using the relative educational level as a measure of skills for each occupation this variable can be analyzed and related to migration. From the results of previous studies it would appear that this independent variable would have its greatest impact on outmigration (Olsen, 1972).

As has been shown in Chapter IV the previous migration of a cohort is an important variable in analyzing migration flows. Through the use of the public use sample data, a migrant stock variable will be operationalized. This variable will reflect the number of persons in the particular occupation that were born out of state, relative to the national mean. This variable will reflect the influence of colleagues from other states in inducing more persons from that occupation to immigrate to the designated state by reducing uncertainty. Similarly, persons who have moved once are more likely to move again, thereby, raising the outmigration rate.

A summary of the model specification presented in this section is summarized in Chart 6-1. The hypothesized directional effects of the various economic and noneconomic variables on in and outmigration rates by occupation are shown.

Chart 6-1

Hypothesized Signs for the Independent Variables

	${}_oY^r$	Δ_oE^i	${}_oH^r$	${}_oL^r$	${}_oM^r$
InMig	+	+	+	?	+
OutMig	-	-	-	-	+

The Occupational Migration Model: Estimation

Unlike the model presented in Chapter IV, this one will be more concerned with analyzing the independent variables, rather than forecasting. As a result, the collinearity among the independent variables should be identified and presented. In order to present evidence on the degree of multicollinearity the determinant of the normalized $|X^tX|$ matrix will be given on each set of independent variables. The determinant of $|X^tX|$ is based on a normalized correlation matrix, and its position on the scale

$$0 \leq |X^tX| \leq 1$$

yields some insight into the degree of interdependence within an independent variable set. As X approaches singularity $|X^tX|$ approaches zero. Conversely $|X^tX|$ close to one implies a nearly orthogonal independent variable set. Unfortunately, the values between these limits is not well defined. However, as an ordinal measure of the relative orthogonality of similar sets of independent variables, the statistic has been used frequently. Although this single, overall measure of the degree of interdepdence is useful in its own right, it provides little information on which corrective action can be based (Farrar and Glauber, 1967).

Before presenting the results of multiple regression analysis on the data, a summary table, Table 6-2, will present the industries whose employment change will be related to in and outmigration for each occupation. The following tables, 6-3 and 6-4, present the results of multiple regression analysis on each occupation for the three designated age groups.

Interpretation

Overall, the model provides evidence on the factors that influence in or outflows by age and occupation. Furthermore, the coefficients of the employment variables are the elasticities with respect to the in or outmigration rate. In almost all cases the fit of the line is better for inmigration than for outmigration. For inmigration, usually four and often more of the independent variables are significant at the ten percent level or better, which supports the underlying theoretical construction and selection of variables. In most all of the occupations, at least one of the inmigration functions explain over sixty percent of the variance. Moreover, the F levels are high and the standard errors of the estimate tend to be low. The variable that is most often significant across occupations for inflows is migrant stock, while the growth in employment of a related industry is generally the second most important variable.

The outmigration equations explain a much smaller percent of the variance than inmigration. Usually, at least one of the three

Table 6-2

Occupation and Related Industry

Occupation	Industries
Professional, technical, and kindred workers	Business, repair, personal, entertainment and recreational, and professional and related services (BRP); Public administration (PA)
Managers and administrators, except farm	Manufacturing, transportation, communications (MTC); Finance insurance and real estate (FIR); Business, repair, personal, entertainment and recreational, and professional and related services; Public administration
Sales workers	Wholesale and retail trade (WRT); Finance insurance and real estate; Business, repair, personal, entertainment and recreational, and professional and related services
Clerical and kindred workers	Manufacturing, transportation, communications; Wholesale and retail trade; Finance insurance and real estate; Business, repair, personal, entertainment and recreational, and professional and related services; Public administration
Craftsmen and kindred workers	Mining and construction (MC); Manufacturing, transportation, communications
Operatives	Mining and construction; Manufacturing, transportation, communications
Transport equipment operatives	Agriculture, forestry, and fisheries (AFF); Mining and construction; Manufacturing, transportation, communications
Laborers, except farm	Manufacturing, transportation, communications; Mining and construction
Service workers, excluding private household	Business, repair, personal, entertainment and recreational, and professional and related services; Public administration
Private household workers	Business, repair, personal, entertainment, and recreational, and professional and related services, and due to this occupation's extremely low income the relative income from public assistance will be implemented (W)

Table 5-9

Occupation Immigration Functions
Professional, Technical, and Kindred Workers

$|X^tX| = .29$

Age 14-24

	$_oY^r$	$_oH^r$	$_oL^r$	$_oM^r$	ΔBRP	ΔPA
b	-.0290	-.019	-.009	.035	.078	-.020
s	.043	.178	.120	.011	.037	.037
t	.669	.107	.074	3.24***	2.13**	.552

Mean = .0502
Intercept = .023
S.S.E. = .022
F = 3.71
R^2 = .34

Age 25-34

	$_oY^r$	$_oH^r$	$_oL^r$	$_oM^r$	ΔBRP	ΔPA
b	-.084	-.155	-.180	.107	.129	.822
s	.0694	.285	.193	.017	.059	.059
t	1.21	.545	.932	6.24***	2.20**	1.40*

Mean = .137
Intercept = .316
S.S.E. = .036
F = 13.48
R^2 = .65

Age 35-64

	$_oY^r$	$_oH^r$	$_oL^r$	$_oM^r$	ΔBRP	ΔPA
b	-.037	.179	-.053	.064	.121	.079
s	.047	.130	.192	.012	.040	.040
t	.790	.929	.406	5.52***	3.07***	1.99**

Mean = .0971
Intercept = -.172
S.S.E. = .024
F = 14.94
R^2 = .67

Table 6-3 (continued)

$|X^tX| = .05$

Occupation Inmigration Functions
Managers and Administrators

Age 14-24

	$_oY^r$	$_oH^r$	$_oL^r$	$_oM^r$	ΔMTC	ΔFIR	ΔBRP	ΔPA
b	-.023	-.029	.080	.010	.021	-.009	-.031	-.017
s	.013	.051	.040	.003	.016	.009	.013	.012
t	1.80**	.579	2.01**	1.39*	1.73**	.926	2.40***	1.39*

Mean = .008
Intercept = -.006
S.S.E. = .069
F = 4.10
R^2 = .44

Age 25-34

	$_oY^r$	$_oH^r$	$_oL^r$	$_oM^r$	ΔMTC	ΔFIR	ΔBRP	ΔPA
b	.005	.131	.244	.023	.002	.023	.118	-.049
s	.045	.176	.139	.011	.056	.033	.045	.042
t	.113	.744	1.75**	1.98**	.034	.695	2.63***	1.16

Mean = .050
Intercept = -.416
S.S.E. = .024
F = 4.79
R^2 = .48

Age 35-64

	$_oY^r$	$_oH^r$	$_oL^r$	$_oM^r$	ΔMTC	ΔFIR	ΔBRP	ΔPA
b	.0089	.026	-.013	.081	.019	.067	.146	-.067
s	.067	.264	.209	.017	.085	.049	.067	.063
t	.133	.100	.06	4.79***	1.36*	2.15**	2.16**	1.06

Mean = .092
Intercept = -.131
S.S.E. = .036
F = 10.31
R^2 = .66

$|X^tX| = .16$

Table 6-3 (continued)

Occupation Immigration Functions
Sales Workers

Age 14-24

	$_oY^r$	$_oH^r$	$_oL^r$	$_oM^r$	ΔWRT	ΔFIR	ΔBRP
b	-.058	-.044	-.102	.045	.236	.066	.015
s	.039	.088	.134	.012	.049	.037	.048
t	1.46*	.493	.766	3.83***	4.82***	.179	.309

Mean = .045
Intercept = .056
S.S.E. = .027
F = 13.8
R^2 = .69

Age 25-34

	$_oY^r$	$_oH^r$	$_oL^r$	$_oM^r$	ΔWRT	ΔFIR	ΔBRP
b	-.050	-.011	-.085	.060	.210	-.024	.078
s	.042	.095	.143	.052	.039	.052	.012
t	1.42*	.120	.594	4.83**	4.02**	.604	1.50*

Mean = .057
Intercept = .007
S.S.E. = .029
F = 14.89
R^2 = .71

Age 35-64

	$_oY^r$	$_oH^r$	$_oL^r$	$_oM^r$	ΔWRT	ΔFIR	ΔBRP
b	-.157	.183	.108	.061	.196	-.011	.064
s	.038	.084	.128	.011	.047	.035	.046
t	4.18***	2.17**	.843	5.53***	4.19***	.308	1.38*

Mean = .066
Intercept = -.277
S.S.E. = .026
F = 20.3
R^2 = .77

Table 6-3 (continued)

$|X^tX| = .06$

Occupation Immigration Functions
Clerical and Kindred Workers

Age 14-24

	$_oY^r$	$_oH^r$	$_oL^r$	$_oM^r$	ΔMTC	ΔWRT	ΔFIR	ΔBRP	ΔPA
b	.106	.285	.366	.042	-.086	.133	.008	.110	-.059
s	.057	.157	.231	.012	.081	.059	.044	.059	.052
t	1.84**	1.82**	1.58*	3.37***	1.05	2.27**	.187	1.86**	1.14

Mean = .0710
Intercept = -.806
S.S.E. = .029
F = 10.88
R^2 = .70

Age 25-34

	$_oY^r$	$_oH^r$	$_oL^r$	$_oM^r$	ΔMTC	ΔWRT	ΔFIR	ΔBRP	ΔPA
b	.034	.229	.074	.030	.0077	.050	.073	.048	.004
s	.030	.081	.120	.064	.042	.030	.023	.031	.027
t	1.13	2.83***	.625	4.80***	.184	1.67**	3.19***	1.57*	.155

Mean = .0575
Intercept = -.407
S.S.E. = .015
F = 23.9
R^2 = .84

Age 35-64

	$_oY^r$	$_oH^r$	$_oL^r$	$_oM^r$	ΔMTC	ΔWRT	ΔFIR	ΔBRP	ΔPA
b	-.09	.303	-.154	.063	.015	.135	.019	.027	-.029
s	.044	.120	.177	.009	.062	.049	.034	.045	.040
t	2.05**	2.52***	.871	6.69***	.241	3.00***	.568	.600	.729

Mean = .0543
Intercept = -.168
S.S.E. = .028
F = 18.3
R^2 = .80

Table 6-3 (continued)

$|X^tX| = .26$

Occupation Immigration Functions
Craftsmen and Kindred Workers

Age 14-24

	${}_oY^r$	${}_oH^r$	${}_oL^r$	${}_oM^r$	ΔMC	ΔMTC
b	-.029	.087	-.006	.015	.0001	.025
s	.011	.086	.030	.003	.014	.019
t	2.53***	1.01	.211	5.33***	.008	1.32*

Mean = .0175
Intercept = -.058
S.S.E. = .008
F = 7.69
R^2 = .51

Age 25-34

	${}_oY^r$	${}_oH^r$	${}_oL^r$	${}_oM^r$	ΔMC	ΔMTC
b	.017	.261	.025	.036	.036	.057
s	.028	.211	.075	.007	.034	.046
t	.599	1.24	.338	5.12***	1.06	1.25

Mean = .0467
Intercept = -.314
S.S.E. = .020
F = 11.96
R^2 = .62

Age 35-64

	${}_oY^r$	${}_oH^r$	${}_oL^r$	${}_oM^r$	ΔMC	ΔMTC
b	-.082	.176	.036	.058	.105	.054
s	.032	.242	.086	.080	.039	.052
t	2.52***	.730	.425	7.17***	2.71***	1.03

Mean = .0506
Intercept = -.177
S.S.E. = .023
F = 18.2
R^2 = .71

Table 6-3 (continued)

$|X^tX| = .24$

Occupation Immigration Functions
Operatives, Except Transport

Age 14-24

	${}_cY^r$	${}_oH^r$	${}_oL^r$	${}_oM^r$	ΔMC	ΔMTC
b	-.0714	.222	.222	.0318	.0296	-.00175
s	.0264	.150	.0732	.00666	.0328	.0471
t	2.704***	1.482*	3.029***	4.778***	.903	.037

Mean = .0422
Intercept = -.360
S.S.E. = .0203
$F =$ 9.412
$R^2 =$ .56

Age 25-34

	${}_oY^r$	${}_oH^r$	${}_oL^r$	${}_oM^r$	ΔMC	ΔMTC
b	-.0737	.199	.165	.0422	.0257	.0422
s	.0270	.154	.0750	.00681	.0336	.0482
t	2.728***	1.298*	2.202**	6.193***	.764	.0945

Mean = .0476
Intercept = -.287
S.S.E. = .0208
$F =$ 11.982
$R^2 =$ .62

Age 35-64

	${}_oY^r$	${}_oH^r$	${}_oL^r$	${}_oM^r$	ΔMC	ΔMTC
b	-.0340	.245	.0850	.0580	.148	.0744
s	.0331	.188	.0917	.00834	.0411	.0590
t	1.028	1.303*	.926	6.962***	3.608***	1.261

Mean = .0461
Intercept = -.356
S.S.E. = .0254
$F =$ 21.859
$R^2 =$ .75

Table 6-3 (continued)

$|X^tX| = .16$

Occupation Inmigration Functions
Transport Equipment Operatives

Age 14-24

	${}_oY^r$	${}_oH^r$	${}_oL^r$	${}_oM^r$	ΔAFF	ΔMC	ΔMTC
b	-.0868	-.117	.171	.0279	-.0339	.0872	-.0433
s	.0335	.0892	.0816	.00636	.0323	.0319	.0497
t	2.595***	1.315*	2.093**	4.384***	1.051	2.736***	.870

Mean = .0237
Intercept = .0351
S.S.E. = .0212
F = 6.723
R^2 = .52

Age 25-34

	${}_oY^r$	${}_oH^r$	${}_oL^r$	${}_oM^r$	ΔAFF	ΔMC	ΔMTC
b	-.0747	.0426	.237	.0422	-.0975	.0651	-.0147
s	.0373	.0993	.0908	.00708	.0359	.0355	.0554
t	2.004**	.429	2.616***	5.955***	2.715***	1.835**	.265

Mean = .0412
Intercept = -.192
S.S.E. = .0236
F = 9.368
R^2 = .60

Age 35-64

	${}_oY^r$	${}_oH^r$	${}_oL^r$	${}_oM^r$	ΔAFF	ΔMC	ΔMTC
b	-.123	.0939	.228	.0305	-.0256	.117	-.00834
s	.0312	.0832	.0760	.00593	.0301	.0297	.0464
t	3.927***	1.128	2.997***	5.151***	.852	3.940***	.180

Mean = .0333
Intercept = -.205
S.S.E. = .0197
F = 11.351
R^2 = .65

Table 6-3 (continued)

$|X^tX| = .25$

Occupation Immigration Functions
Laborers

Age 14-24

	${}_oY^r$	${}_oH^r$	${}_oL^r$	${}_oM^r$	ΔMC	ΔMTC
b	-.0662	-.141	.112	.0491	.0809	.0283
s	.0285	.107	.0535	.00739	.0329	.0513
t	2.326***	1.322*	2.083**	6.638***	2.457***	.552

Mean = .0524
Intercept = .0744
S.S.E. = .0220
F = 15.41
R^2 = .68

Age 25-34

	${}_oY^r$	${}_oH^r$	${}_oL^r$	${}_oM^r$	ΔMC	ΔMTC
b	.0931	-.156	-.0382	.0261	.0935	.0191
s	.0454	.170	.0855	.0118	.0526	.0819
t	2.050**	.916	.447	2.214**	1.778**	.234

Mean = .0355
Intercept = .0870
S.S.E. = .0352
F = 5.197
R^2 = .41

Age 35-64

	${}_oY^r$	${}_oH^r$	${}_oL^r$	${}_oM^r$	ΔMC	ΔMTC
b	.0104	-.0960	-.0105	.0268	.116	.00581
s	.0290	.109	.0546	.00753	.0335	.0523
t	.359	.884	.193	3.558***	3.462***	.111

Mean = .0310
Intercept = .0755
S.S.E. = .0225
F = 8.003
R^2 = .52

Table 6-3 (continued)

$|X^tX| = .16$

Occupation Immigration Functions
Service Workers, Except Private Household

Age 14-24

	${}_oY^r$	${}_oH^r$	${}_oL^r$	${}_oM^r$	ΔBRP	ΔPA
b	-.0756	.0831	.117	.0560	.183	-.0580
s	.0254	.0964	.142	.0129	.0443	.0419
t	2.979***	.862	.821	4.336***	4.123***	4.336***

Mean = .0606
Intercept = -.219
S.S.E. = .0265
F = 12.178
R^2 = .62

Age 25-34

	${}_oY^r$	${}_oH^r$	${}_oL^r$	${}_oM^r$	ΔBRP	ΔPA
b	.00519	.108	-.0303	.0521	.0803	.0353
s	.0260	.0990	.146	.0133	.0455	.0429
t	.724	.199	1.088	3.932***	.207	.822

Mean = .0457
Intercept = -.153
S.S.E. = -.0272
F = 9.206
R^2 = .56

Age 35-64

	${}_oY^r$	${}_oH^r$	${}_oL^r$	${}_oM^r$	ΔBRP	ΔPA
b	-.0399	.237	-.0248	.072	.174	-.0522
s	.0259	.0987	.146	.0132	.0454	.0428
t	1.503*	2.40***	.170	5.478***	3.83***	1.220

Mean = .0614
Intercept = -.316
S.S.E. = .0271
F = 18.999
R^2 = .72

$|X^tX| = .37$

Table 6-3 (continued)

Occupation Inmigration Functions
Private Household Workers

Age 14-24

	${}_oY^r$	${}_oH^r$	${}_oL^r$	${}_oM^r$	W
b	-.184	-.355	-.359	.0782	.145
s	.0654	.143	.225	.0307	.0433
t	2.812***	2.489***	1.597*	2.549***	3.360***

Mean = .0859
Intercept = .716
S.S.E. = .106
F = 7.138
R^2 = .44

Age 25-34

	${}_oY^r$	${}_oH^r$	${}_oL^r$	${}_oM^r$	W
b	.0270	-.196	.191	.0251	-.0598
s	.0561	.123	.193	.0263	.0371
t	.482	1.595*	.991	.953	1.611**

Mean = .0343
Intercept = .0374
S.S.E. = .0907
F = 1.972
R^2 = .18

Age 35-64

	${}_oY^r$	${}_oH^r$	${}_oL^r$	${}_oM^r$	W
b	-.175	.194	-.102	.119	.00910
s	.0423	.0923	.145	.0198	.0280
t	4.129***	2.106**	.699	6.005***	.325

Mean = .0724
Intercept = .0137
S.S.E. = .0684
F = 8.719
R^2 = .49

Table 6-4

Occupation Outmigration Functions
Professional, Technical, and Kindred Workers

$|X^tX| = .29$

Age 14-24

	${}_oY^r$	${}_oH^r$	${}_oL^r$	${}_oM^r$	ΔBRP	ΔPA
b	-.126	-.106	.0947	-.0009	.007	-.062
s	.059	.241	.163	.014	.050	.050
t	2.13**	.442	.579	.060	.144	1.24

Mean = .0520
Intercept = .201
S.S.E. = .030
F = 1.74
R^2 = .19

Age 25-34

	${}_oY^r$	${}_oH^r$	${}_oL^r$	${}_oM^r$	ΔBRP	ΔPA
b	-.262	-.078	.327	.066	.071	-.121
s	.096	.391	.265	.024	.081	.081
t	2.74***	.199	1.23	2.80***	.883	1.49*

Mean = .141
Intercept = -.082
S.S.E. = .049
F = 3.05
R^2 = .29

Age 35-64

	${}_oY^r$	${}_oH^r$	${}_oL^r$	${}_oM^r$	ΔBRP	ΔPA
b	-.122	.384	-.047	.104	.064	-.153
s	.077	.316	.214	.019	.065	.065
t	1.58*	1.21	.220	5.45***	.992	2.35***

Mean = .0943
Intercept = -.222
S.S.E. = .040
F = 7.74
R^2 = .51

Table 6-4 (continued)

$|X^tX| = .05$

Occupation Outmigration Functions
Managers and Administrators

Age 14-24

	${}_oY^r$	${}_oH^r$	${}_oL^r$	${}_oM^r$	ΔMTC	ΔFIR	ΔBRP	ΔPA
b	-.034	.001	-.055	.011	-.0829	.004	.078	-.0032
s	.024	.095	.075	.006	.030	.018	.024	.023
t	1.42*	.013	.734	1.86**	2.70***	.224	3.24***	.141

Mean = .012
Intercept = .057
S.S.E. = .013
F = 2.94
R^2 = .36

Age 25-34

	${}_oY^r$	${}_oH^r$	${}_oL^r$	${}_oM^r$	ΔMTC	ΔFIR	ΔBRP	ΔPA
b	-.029	.387	.269	.054	-.155	-.079	.173	-.071
s	.068	.269	.212	.017	.086	.050	.069	.064
t	.424	1.44*	1.27	3.12***	1.80**	1.58*	2.51***	1.10

Mean = .053
Intercept = -.611
S.S.E. = .036
F = 3.24
R^2 = .38

Age 35-64

	${}_oY^r$	${}_oH^r$	${}_oL^r$	${}_oM^r$	ΔMTC	ΔFIR	ΔBRP	ΔPA
b	-.054	-.013	.149	.068	-.151	-.053	.060	-.050
s	.061	.238	.188	.015	.076	.045	.061	.057
t	.890	.051	.789	4.44***	1.98**	1.18	.987	.880

Mean = .084
Intercept = -.007
S.S.E. = .032
F = 4.59
R^2 = .47

Table 6-4 (continued)

$|X^tX| = .16$

Occupation Outmigration Functions
Sales Workers

Age 14-24

	$_oY^r$	$_oH^r$	$_oL^r$	$_oM^r$	ΔWRT	ΔFIR	ΔBRP
b	-.125	.021	.233	.031	-.022	-.047	.088
s	.046	.103	.155	.135	.057	.043	.056
t	2.73***	.204	1.50*	2.32**	.391	1.11	1.56*

Mean = .046
Intercept = -.138
S.S.E. = .032
F = 2.47
R^2 = .29

Age 25-34

	$_oY^r$	$_oH^r$	$_oL^r$	$_oM^r$	ΔWRT	ΔFIR	ΔBRP
b	-.069	-.026	-.048	.046	.144	-.002	.109
s	.072	.161	.244	.021	.089	.067	.088
t	.959	.161	.195	2.15**	1.61*	.026	1.23

Mean = .063
Intercept = .021
S.S.E. =
F = 3.48
R^2 = .36

Age 35-64

	$_oY^r$	$_oH^r$	$_oL^r$	$_oM^r$	ΔWRT	ΔFIR	ΔBRP
b	-.107	-.014	.184	.071	.008	-.030	.090
s	.079	.178	.269	.023	.098	.074	.097
t	1.36*	.079	.683	3.04***	.085	.406	.924

Mean = .073
Intercept = -.113
S.S.E. = .055
F = 2.98
R^2 = .33

Table 6-4 (continued)

$|X^tX| = .06$

Occupation Outmigration Functions
Clerical and Kindred Workers

Age 14-24

	${}_{c}Y^{r}$	${}_{o}H^{r}$	${}_{o}L^{r}$	${}_{o}M^{r}$	ΔMTC	ΔWRT	ΔFIR	ΔBRP	ΔPA
b	-.391	.662	.107	.037	-.442	.028	-.028	.128	.037
s	.062	.169	.249	.013	.088	.063	.048	.064	.056
t	6.32***	3.92***	.430	2.82***	5.04***	.440	.586	2.01**	.656

Mean = .0829
Intercept = -.30
S.S.E. = .032
F = 8.36
R^2 = .65

Age 25-34

	${}_{o}Y^{r}$	${}_{o}H^{r}$	${}_{o}L^{r}$	${}_{o}M^{r}$	ΔMTC	ΔWRT	ΔFIR	ΔBRP	ΔPA
b	-.18	.431	.204	.057	-.352	.121	-.047	.093	-.068
s	.065	.178	.262	.014	.092	.066	.050	.067	.058
t	2.81***	2.43***	.789	4.09***	3.81***	1.82**	.938	1.38*	1.17

Mean = .0661
Intercept = -.400
S.S.E. = .034
F = 5.33
R^2 = .54

Age 35-64

	${}_{o}Y^{r}$	${}_{o}H^{r}$	${}_{o}L^{r}$	${}_{o}M^{r}$	ΔMTC	ΔWRT	ΔFIR	ΔBRP	ΔPA
b	-.141	.285	.213	.058	.270	.241	.036	.102	-.119
s	.068	.186	.274	.015	.096	.069	.053	.070	.061
t	2.07**	1.54*	.778	3.97***	2.80***	.348	.687	1.45*	1.95**

Mean = .0604
Intercept = .323
S.S.E. = .035
F = 5.92
R^2 = .56

$|X^tX| = .26$

Table 6-4 (continued)

Occupation Outmigration Functions
Craftsmen and Kindred Workers

Age 14-24

	${}_oY^r$	${}_oH^r$	${}_oL^r$	${}_oM^r$	ΔMC	ΔMTC
b	-.055	.141	.009	.019	.009	-.079
s	.022	.168	.059	.006	.027	.036
t	2.44**	.833	.149	3.42***	.330	2.18**

Mean = .0210
Intercept = -.069
S.S.E. = .016
$F =$ 3.29
$R^2 =$ .31

Age 25-34

	${}_oY^r$	${}_oH^r$	${}_oL^r$	${}_oM^r$	ΔMC	ΔMTC
b	-.011	.656	-.031	.040	-.064	-.046
s	.046	.344	.122	.011	.055	.074
t	.245	1.91**	.259	3.48***	1.15	.618

Mean = .0484
Intercept = -.574
S.S.E. = .033
$F =$ 3.55
$R^2 =$ .33

Age 35-64

	${}_oY^r$	${}_oH^r$	${}_oL^r$	${}_oM^r$	ΔMC	ΔMTC
b	-.0378	.470	-.0385	.0595	-.0661	-.146
s	.0493	.369	.130	.0123	.0592	.0795
t	.767	1.274	.295	4.847***	1.118	1.832**

Mean = .0518
Intercept = -.340
S.S.E. = .035
$F =$ 6.16
$R^2 =$ .46

Table 6-4 (continued)

$|X^tX| = .24$

Occupation Outmigration Functions
Operatives, Except Transport

Age 14-24

	$_oY^r$	$_oH^r$	$_oL^r$	$_oM^r$	ΔMC	ΔMTC
b	-.135	.766	.282	.0201	-.00233	-.0966
s	.0457	.260	.127	.0115	.0568	.0815
t	2.959***	2.953***	2.225**	1.747**	.041	1.185

Mean = .0441
Intercept = -.840
S.S.E. = .0351
F = 2.984
R^2 = .29

Age 25-34

	$_oY^r$	$_oH^r$	$_oL^r$	$_oM^r$	ΔMC	ΔMTC
b	-.0490	1.179	.440	.0356	.0762	-.197
s	.0901	.512	.250	.0227	.112	.161
t	.543	2.302**	1.760***	1.567*	.680	1.224

Mean = .0639
Intercept = -.0146
S.S.E. = .0693
F = 2.828
R^2 = .28

Age 35-64

	$_oY^r$	$_oH^r$	$_oL^r$	$_oM^r$	ΔMC	ΔMTC
b	-.124	.962	.361	.0410	-.0878	-.122
s	.0585	.332	.162	.0147	.0727	.104
t	2.120**	2.896***	2.226**	2.780***	1.209	1.172

Mean = .0482
Intercept = -1.114
S.S.E. = .0450
F = 4.893
R^2 = .40

Table 6-4 (continued)

$|X^tX| = .16$

Occupation Outmigration Functions
Transport Equipment Operatives

Age 14-24

	${}_oY^r$	${}_oH^r$	${}_oL^r$	${}_oM^r$	ΔAFF	ΔMC	ΔMTC
b	-.167	.107	.267	.0385	-.130	.0103	-.140
s	.0307	.0818	.0747	.00583	.0296	.0292	.0456
t	5.457***	1.309*	3.580***	6.616***	4.411***	.354	3.070***

Mean = .0241
Intercept = -.167
S.S.E. = .0194
F = 10.119
R^2 = .62

Age 25-34

	${}_oY^r$	${}_oH^r$	${}_oL^r$	${}_oM^r$	ΔAFF	ΔMC	ΔMTC
b	.0154	.197	-.213	.0369	-.0146	-.0421	-.00541
s	.0367	.0979	.0895	.00698	.0354	.0350	.0546
t	.418	2.013**	2.379***	5.286***	.413	1.204	.0991

Mean = .0373
Intercept = .00560
S.S.E. = .0232
F = 4.661
R^2 = .43

Age 35-64

	${}_oY^r$	${}_oH^r$	${}_oL^r$	${}_oM^r$	ΔAFF	ΔMC	ΔMTC
b	-.0520	.114	.0418	.0611	-.103	.0582	-.162
s	.161	.0555	.148	.106	.135	.0535	.0529
t	.937	.771	.309	5.787***	1.931**	1.101	1.968**

Mean = .0361
Intercept = -.0704
S.S.E. = .0351
F = 6.223
R^2 = .50

Table 6-4 (continued)

$|X^tX| = .25$

Occupation Outmigration Functions
Laborers

Age 14-24

	${}_{o}Y^{r}$	${}_{o}H^{r}$	${}_{o}L^{r}$	${}_{o}M^{r}$	ΔMC	ΔMTC
b	-.0785	.193	.0563	.0237	.0636	-.0733
s	.0412	.154	.0776	.0107	.0477	.0743
t	.642	1.903**	1.252	2.211**	1.334**	.986

Mean = .0537
Intercept = -.126
S.S.E. = .0319
F = 1.621
R^2 = .18

Age 25-34

	${}_{o}Y^{r}$	${}_{o}H^{r}$	${}_{o}L^{r}$	${}_{o}M^{r}$	ΔMC	ΔMTC
b	-.0690	-.0794	-.0349	.0274	-.0228	-.107
s	.0299	.112	.0562	.00776	.0346	.0539
t	2.310**	.710	.622	3.536**	.661	1.983**

Mean = .0349
Intercept = .224
S.S.E. = .0213
F = 2.526
R^2 = .26

Age 35-64

	${}_{o}Y^{r}$	${}_{o}H^{r}$	${}_{o}L^{r}$	${}_{o}M^{r}$	ΔMC	ΔMTC
b	-.0337	.0434	-.0868	.0419	-.0812	-.0350
s	.0281	.105	-.0529	.00731	.326	.507
t	1.199	.412	1.639**	5.735***	2.494***	.691

Mean = .0278
Intercept = .0858
S.S.E. = .0218
F = 6.298
R^2 = .46

Table 6- (continued)

$|X^tX| = .16$

Occupation Outmigration Functions
Service Workers, Except Private Household

Age 14-24

	${}_oY^r$	${}_oH^r$	${}_oL^r$	${}_oM^r$	ΔBRP	ΔPA
b	-.102	-.139	-.316	.0501	.0694	-.00737
s	.0289	.110	.162	.0147	.0506	.0478
t	3.529***	1.265	1.943**	3.400***	1.371*	.154

Mean = .0600
Intercept = .499
S.S.E. = .0303
F = 3.956
R^2 = .35

Age 25-34

	${}_oY^r$	${}_oH^r$	${}_oL^r$	${}_oM^r$	ΔBRP	ΔPA
b	-.0619	.0740	-.119	.0385	.0412	-.0545
s	.0219	.0831	.123	.0111	.0382	.0361
t	2.835***	.890	.972	3.463***	1.079	1.512*

Mean = .0412
Intercept = .0948
S.S.E. = .0228
F = 3.567
R^2 = .33

Age 35-64

	${}_oY^r$	${}_oH^r$	${}_oL^r$	${}_oM^r$	ΔBRP	ΔPA
b	-.0440	.132	-.0668	.0461	.0721	-.0409
s	.0291	.111	.163	.0148	.0509	.0480
t	.205	1.513*	1.192	3.113***	.409	1.418*

Mean = .0543
Intercept = -.0483
S.S.E. = .0304
F = 3.636
R^2 = .33

$|X^tX| = .37$

Table 6-4 (continued)

Occupation Outmigration Functions
Private Household Workers

Age 14-24

	${}_oY^r$	${}_oH^r$	${}_oL^r$	${}_oM^r$	W
b	-.0381	-.351	.334	.00461	.0229
s	.116	.254	.401	.0546	.0771
t	.327	1.382*	.833	.084	.298

Mean = .0820
Intercept = .0927
S.S.E. = .188
F = 1.525
R^2 = .14

Age 25-34

	${}_oY^r$	${}_oH^r$	${}_oL^r$	${}_oM^r$	W
b	.00134	-.0698	.0894	.000941	-.0180
s	.0309	.0674	.106	.0145	.0204
t	.0436	1.006	.842	.0650	.883

Mean = .0188
Intercept = .0102
S.S.E. = .0499
F = .789
R^2 = .08

Age 35-64

	${}_oY^r$	${}_oH^r$	${}_oL^r$	${}_oM^r$	W
b	-.0915	.337	.466	.0540	-.0256
s	.0486	.106	.167	.0228	.0322
t	1.882**	3.176***	2.790***	2.367***	.796

Mean = .0653
Intercept = -.659
S.S.E. = .0786
F = 5.194
R^2 = .37

outmigration equations for each occupation can explain forty percent of the variance, and most all of the equations have significant F levels at the .05 level. Most often, three of the independent variables are significant, and migrant stock is the most consistently significant variable. Relative income plays a more important role in explaining outmigration. It is almost always negative as hypothesized and is usually significant in two of the three cases.

Although the determinant of the normalized $|X^tX|$ matrix shows the existence of some multicollinearity, in comparison with the other article on migration which has presented this evidence the results in this chapter are considerably better (Bowles, 1970). Bowles' article on "Migration as Investment" presented three O.L.S. equations with $|X^tX|$ values ranging from .04 to .14. In no case are the values presented in Tables 6-3 and 6-4 worse than .04 and in eight of ten sets of independent variables the values are greater than or equal to .16. Using the Bowles' article, which used similar independent variables on a different time period, as a basis of comparison, the explanatory variables in this paper exhibit less collinearity.

Professional, Technical, and Kindred Workers

This occupational group experiences the greatest interstate mobility (i.e., mean between .137 and .141 for those aged 25-34). Since there are few persons in this occupation between 14-24, the latter two age groups more accurately reflect the interstate migration of this cohort. For inmigration, the coefficient of determination is high-- $R^2 = .65$ and $R^2 = .67$. In all three age groups relative migrant stock is the most significant variable, while the change in business and professional employment is the second most important independent variable, followed by the employment change in public administration. Relative income, hours worked, and educational level are not significant and generally do not possess the hypothesized sign.

For outmigration, professional and technical workers appear to be greatly influenced by the relative income level; that is, the lower the income the greater the outmigration rate. In addition, migrant stock is positive, and significant in two of the three cases. The employment change in public administration always possesses the hypothesized negative sign and is also significant in two of the three cases. Overall, there appears to be a dichotomy between the factors influencing each flow. For inmigration of professionals, the informal channels of information, which migrant stock suggests, and related employment change appear most important. On the other hand, income levels and, to a lesser degree, lack of employment growth appear to influence outmigration, although not as much of the variance can be explained.

Managers and Administrators

Out of all the occupations in this survey, managers and administrators had the highest mean yearly income (i.e., $12,178 in 1969). In addition, since this occupational category is mainly comprised of other occupations that have been promoted, the mean age of this cohort tends to be high. This is reflected, to some extent, in the higher explanatory power of the last equation for both in and outmigration.

For inmigration, the employment change in business and professional services is the most significant variable. Migrant stock is the second most significant variable and it becomes more important with age. Again, relative income, hours, and education appear to play a small role in explaining this group's inmigration to a state.

The outmigration functions for managers and administrators show much similarity to professional and technical workers. There exists the hypothesized negative relationship between income and outmigration, although it is not as strong as for the professional and technical cohorts. The migrant stock variable dominates the others, in two of the three cases. In addition, employment change in manufacturing is significant and possess the assumed negative sign in all three cases.

Sales Workers

Sales workers include a variety of three digit occupations. This varies from "newsboys--266" to "insurance agents, brokers, and underwriters--265." Overall, the inmigration function explains between 69 and 77 percent of the variation of state inflows. On the other hand, the outmigration function explains only between 29 and 33 percent of the variation in outmigration.

The sales workers' inmigration functions show that both the change in employment in wholesale and retail trade and the migrant stock variable are statistically significant at the .01 level in all three cases. It is of some interest to note that relative income is negatively related to inmigration, and that high income may be the result of fewer sales persons covering a larger geographic territory. In addition, the inclusion of such divergent occupations within one category may lead to this unexpected result. However, the advantages to be gained by standardization of occupational categories are of considerably greater weight.

For outmigration, relative migrant stock and per capita income are the most significant variables. Migrant stock has the hypothesized positive sign, and per capita income has the assumed negative sign in all cases. Unlike the other occupations, the employment change in the related industries seems to have a small effect on the outmigration of sales workers.

Clerical and Kindred Workers

Despite the somewhat high multicollinearity (i.e., $|X^tX| = .06$), the model appears to perform best for this occupational category. In general, the coefficient of determination is high for in and outmigration (e.g., $R^2 = .84$ for inmigration aged 25-34, and $R^2 = .65$ for outmigration aged 14-24). The F test values are significant, and the standard errors tend to be low. Although more independent variables were used in these equations, the generally "correct" signs and significance of the variables seem to further justify their inclusion in the model.

For inmigration, relative migrant stock, weekly hours worked, and income are all highly significant and positive as hypothesized. Generally, the percent employment change in related industries tends to be important and has a positive sign, with wholesale and retail trade, and business and professional services obtaining the highest statistical significance.

For clerical and kindred workers the relative income variable and migrant stock variables are highly significant, and are of the postulated negative and positive signs respectively. The coefficients on employment change in related industries are generally of the hypothesized sign with the manufacturing industry showing the greatest statistical significance.

Craftsmen and Kindred Workers

This category contains occupations which require little more than twelve years of formal schooling, but often several years of on-the-job training. Salaries are higher than the mean for all occupations (i.e., $8,024). The model appears to perform better for older age groups than for younger ones, and this is shown by the higher coefficient of determination, .71 for those persons 35-64 for inmigration and $R^2 = .46$ for the same age group for outmigration.

Craftsmen and kindred workers' inmigration functions follow a pattern similar to the other groups examined thus far. However, migrant stock dominates the other variables and only relative income is significant more than once, and it has a negative sign in two of the three cases. The change in employment variables are statistically significant only once each, but they possess the hypothesized positive sign.

The outmigration functions show that the migrant stock variable is the most significant one, and is positive. The employment elasticities of manufacturing are significant in two of three cases, and are negative in all three cohorts. Relative income is also universally negative, but significant only once.

Operatives, except Transport

Unlike many of the other occupational categories, this one appears more responsive to the relative economic factors like income, hours worked, educational level, and migrant stock. The employment elasticities are only significant in one of the twelve cases, although they maintain the hypothesized sign in ten of twelve cases. This may be due in part to their low income relative to other occupations in industrial settings (i.e., \$5,314). The R^2 for inmigration is fairly high (e.g., $R^2 = .75$ for those aged 35-64), and somewhat lower for outmigration (e.g., $R^2 = .40$ for those aged 35-64).

The inmigration equations show income, hours worked, educational level, and migrant stock significant in at least two of the three cases, although income does not possess the hypothesized sign. The only significant employment change by industry is mining and construction for those persons aged 35-64. This responsiveness to the relative weekly hours variable reflects the responsiveness of this relatively low income occupation to regional labor markets.

For outmigration, the results show relative income is significant in two of three cases and possesses the assumed negative sign in all cases. Both the educational level and migrant stock variables are significant, and have the suspected positive sign. Only the relative weekly hours worked variable does not have the suspected sign. In no case are the related industry elasticities significant, but they possess the postulated signs in five of six cases.

Transport Equipment Operatives

A comparison of transport equipment operatives with operatives shows that the former have higher total income (i.e., \$6,714 to \$5,314) and work more hours (i.e., 42 to 39). As a result the degree to which factors influence this occupational group are somewhat different than those that influence operatives. The R^2 values for inmigration range from .52 for the youngest cohort to .65 for the oldest cohort. In sharp contrast, the outmigration functions R^2 decrease with age from .65 for the youngest group to .50 for those aged 35-64.

The factors that show the greatest statistical significance for inmigration are the relative migrant stock, the relative educational level, the percentage change in employment in mining and construction, and relative total income. All but relative total income have the hypothesized positive signs. For this occupational inflow between four and five of the independent variables are significant, which further supports the selection of variables.

Transport equipment operatives outmigration functions explain almost as much of the variance as do the inmigration equations. Migrant stock and the employment elasticities are significant most often, and almost always possess the hypothesized sign. The relative total income variable is significant and negative for the youngest age group, but loses much of its significance for the other cohorts.

Laborers

Laborers' total income and hours worked are low compared to most of the occupational groups in this study. Mean total income is \$4,463 per year and mean weekly hours worked are 35.7. Since many laborers tend to move into one of the operative or craftsmen occupations with age, the variables chosen for inmigration explained more of the variance for the younger age groups. The coefficients of determination are .68 for those aged 14-24, .41 for those aged 25-34, and .52 for those aged 35-64.

The most significant variables for inmigration are migrant stock, and the employment change in mining and construction. Total income is significant in two of three cases, and also possesses the hypothesized positive sign for two of the three age groups. The other variables tend not to be significant for the inmigration of laborers.

For outmigration, the R^2's are lower than for inmigration, but tend to increase with age. Migrant stock and the employment change in mining and construction are the most statistically significant variables, and almost always have the respective positive and negative signs. Relative income, though it always has the hypothesized negative sign, is significant only once.

Service Workers, except Private Household

Service workers include a wide variety of three digit occupations. For example, cleaners and charwomen--902, practical nurses--926, and police and detectives--964, are all included in this larger occupational category. By way of comparison with the other occupational groups, the R^2's and the F levels are generally high for inmigration but low for outmigration.

The inmigration functions show that migrant stock is the most consistently significant variable, but that the employment elasticities are significant for the youngest age group. The weekly hours worked variable is positive as assumed in all cases, and is statistically significant for only the last age group. Both relative income and education are more often negative than positive, and are significant in three of the six cases.

The service workers' outmigration equations are similar to those of the other occupations examined. As usual, migrant stock is positive and significant in all three cases. Relative total income is universally negative, and is statistically significant in two of the three cases. In addition, the change in employment is always negative, and is also significant for two of the three cohorts.

Private Household Workers

This occupational cohort provides a striking contrast to the others that have been discussed. Private household workers rank by far the lowest in total yearly income ($1,404), weekly hours worked (27.3), and educational level (10.8 years of school). In addition, the three digit occupations that comprise this larger category primarily consist of women. In analyzing the statistical data, the coefficients of determination are lower for this group than for the other occupations. However, the $|X^tX|$ value of .37 is the highest, indicating less collinearity among the independent variables. Furthermore, an income from public assistance variable was introduced in order to relate its affect on a low income occupation.

The inmigration functions show that migrant stock is significant in two cohorts, and has the postulated positive sign in all three cases. The relative public assistance variable is significant in two of the three age groups, and has the assumed sign twice. The weekly hours worked is statistically significant in all cases, but has the hypothesized sign only once. Income is significant twice, but has a negative sign in both cases.

For outmigration, the R^2 values are .14 for those aged 14-24, and .08 for those aged 25-34, but it is .37 for those aged 35-64. The F value is significant for the last age group. Weekly hours worked is significant most often, and it has the hypothesized negative sign twice. Relative total income is negative twice, and significant for those aged 35-64. Surprisingly, migrant stock is only significant once. Finally, the welfare variable has the hypothesized negative sign in two of the three age cohorts, but is not significantly different from zero.

Additional Comments

This chapter has attempted to show the extent to which occupational migration by state can be related to relative supply and demand features for that cohort. Overall, the models perform well for most occupations and age groups. It is apparent that, excluding the migrant stock variable, different economic factors influence the interstate migration of the various occupations. The analysis also shows that the degree of significance and signs of the independent variables change with age groups within occupations. Moreover, the factors that influence inmigration are often times different from the factors that influence outmigration. Any state manpower policy which is concerned with attracting or retaining migrants of a particular occupation should at least be aware of the factors that influence these movements.

CHAPTER VIII

POLICY AND SUMMARY

In the United States a man builds a house in which to spend his old age, and he sells it before the roof is on; he plants a garden and lets it just as the trees are coming into bearing; he brings a field into tillage and leaves other men to gather the crops; he embraces a profession and gives it up; he settles in a place, which he soon afterwards leaves to carry his changeable longings elsewhere ....

Alexis de Tocqueville
Democracy in America

Introduction

The previous chapters have stated the long run trends, developed a method for projections, and have analyzed migration occupational patterns. This final chapter will state what public policy has stated with respect to population distribution, and briefly relate what other countries' policies have been toward migration. In addition, a summary will be presented, and some suggestions will be made for areas of future research.

Public Policy and Migration

The major legal decisions affecting regional population distribution has invoked the concept of negative freedom in upholding the right of individuals to settle where they wish. A paradigm case is Edwards vs. California (1941), in which the Supreme Court declared unconstitutional a California law making it illegal to bring an indigent person into a state. Two basic lines of argument were involved. One held that the law was an unconstitutional interference with interstate commerce. However, Justice Douglas held that the law was unconstitutional because it interfered with the basic right to travel: "The right to move freely from state to state is an incident of national citizenship protected by the privileges and immunities clause of the Fourteenth Amendment against state interference." The only qualifications the Supreme Court has been willing to place on freedom of migration are those growing out of a "compelling national interest," as in Korematsu vs. United States (1944). In this case, the Court upheld the removal of Japanese and American citizens of Japanese ancestry from a large area of the West Coast and their confinement in detention centers. If these precedents were followed in Court evaluations of population policies aimed at redistributing the population, any compulsory policies would be hard to justify (Parke and Westaff, 1972).

Legislative policy with respect to any major efforts toward population distribution occurred in the previous century. This consisted of the Preemption Act of 1841 and the General Land Revision Act of 1891 which sold small shares of land at nominal or no cost, and served a useful tool by the federal government to achieve population redistribution (Aspects of Population Growth Policy, 1972). However, most all mobility in recent times has occurred as a result of the factors discussed in the previous chapters. Although there has been little federal policy with respect to mobility in this country, other countries' policies may provide useful suggestions for the United States.

Migration Policy in Other Countries

Perhaps the nation best known for its policies to stimulate geographic mobility in market-indicated directions is Sweden. This has been done by extending, up to certain maxima, grants intended as reimbursements for costs to workers who must move to new employments in other locations and by family maintenance grants to those who must leave dependents behind as they move to other areas. Uhr describes the Swedish experience as follows:

> ... travel costs for seeking new work in distant locations are advanced or reimbursed to workers referred by the employment offices. If the workers secure work there, they may apply for "starting allowances," equal to about two to three weeks' wages, to get settled temporarily, while their dependents are on maintenance allowances for a period of up to nine months. During this time the workers must try to find adequate housing so that their families can be moved. These allowances are intended to be sufficient to meet the extra costs of moving and of separate temporary maintenance of dependents at a modest consumption standard (Uhr, 1967, p. 149).

Unlike Swedish migration policy that is within the context of full employment, economic growth, and balanced distribution of economic activities, Great Britain and France have had a more scattered approach. Klaassen and Drewe state that there is a strong impression of undue influence of British regional policy on migration policy. As a result it has been of limited assistance to the unemployed rather than forming an essential part of labor market policy. French migration policy can be considered even more limited than the British. It can be categorized as assisting the unemployed to take jobs in other areas provided that no work is available locally, and they do not choose the Paris region. The effect of the objective is a limited contribution to a much broader goal: the attainment of an optimal distribution of workers between jobs and regions (Klaassen and Drewe, 1973).

No benefit-cost measures have been applied to evaluate these programs either in terms of efficiency or equity. In the United States, federal policy has been limited to demonstration projects that have for the most part been sponsored by the Department of Labor. Optimum distribution across space is not likely to be realized in the absence of governmental intervention; since there are often too many externalities and too little information available to most individuals (Spengler, 1974).

With the birth rate declining below zero population growth (Z.P.G.), the importance of in and outmigration becomes more apparent. In the past, states which had large numbers of outmigrants relative to inmigrants could count on a high fertility rate to maintain or increase total population. With this no longer the case, the maintenance and improvement of the population and labor force of an area can only be attained through inmigration. As a result, federal or state policy much like these European incentives may be implemented to induce persons of alternative ages, occupations, and skills to migrate to areas with considerable fixed capital, but lacking a skilled labor force.

Summary

The first chapter presents the goals and purpose of this study. Within this context, an overview of the project is presented which details the methodological difficulties that exist in manpower forecasting. In addition, the relationship between this project and other manpower research currently being undertaken at the University of Illinois, Center for Advanced Computation is stated. Finally, the usefulness of this study for manpower planning is enumerated, and the criteria for an evaluation of forecasts within this setting is specified. Overall, it provides an introduction and backdrop for the theory, forecasts, and analysis which follows.

The following chapter details the three major currents of migration during the first seventy years of this century. First, the movement westward, the migration from South to North, and the flows from rural areas to cities are enumerated. These flows are discussed in the context of major historical events. Next, the long run effects of economic opportunity on migration are discussed. The chapter concludes by stating the importance of informal channels of information for inducing further migration.

Chapter III reviews and further develops the theory of migration upon which the empirical analysis is based. Alternative definitions of migration are presented, and the economic rationale of the process for individuals is stated. Next, a review of the literature on migration and economic growth along with a critique of current models is detailed. A regional labor market model is presented both verbally and mathematically, and a solution for migration is obtained in terms of exogenous variables and parameters. The rest of the chapter is spent presenting the case for disaggregating this simple model by in and outmigration, color, age, and occupation so that it can be of greater use in analyzing regional labor markets and for use in manpower planning.

In Chapter IV an interstate migration forecasting model is developed. First, a review of past attempts to forecast migration is presented, and a critique of each method is stated. Secondly, a discussion of alternative data used in migration analysis is presented, and the advantages to be gained by using the computer tapes from the Bureau of the Census Subject Report PC2-2B is stated. In addition, an econometric analysis of the use of pooled cross section data, and weighted regression is enumerated. Thirdly, two separate models, one for inmigration by age and race and the second one for outmigration by age and race, are specified. Fourthly, the results of multiple regression analysis on the specified models are presented. Although problems exist in interpreting reduced form parameters with multicollinearity, a modest attempt is provided into the relationships via the regression coefficients and their signs. In sum, the results of this chapter adds support to the validity of a socio-economic model to the explanation and prediction of migration.

Chapter V develops a method for an analysis and implementation of a migration forecast. Alternative methods of verification are discussed, and Theil's U statistic is chosen to analyze the model. Next, matrix methods of forecasting migration are discussed, and the specific procedure to be used in this chapter to test a smaller version of the model (R_2) is presented. The R_2 model was operationalized and found sufficiently similar to the original model to test against a part-rates method of forecasting for fifteen states during the period 1965-70. Overall, the regression method was able to detect positive and negative changes in each flow and does better than past-rates at avoiding extreme errors. This method is sufficiently encouraging as a technique for forecasting so that illustrative forecasts are made for

Illinois by age and color at five year intervals to 1985, using three alternative economic forecasts of the state economy. The policy implications of these forecasts for a variety of state services are discussed. This section concludes by stating the importance of socio-economic influences on population, and its importance in population forecasting.

The following chapter analyzes and tests a model of occupational mobility for ten aggregated occupations and three age groups. The data for this analysis is obtained from the public use samples of basic records from the 1970 Census, and an example of the data used is presented in Table 6-1. The basic relationships in terms of which model specification are discussed is presented. Separate multiple regressions on in and outmigration by age and occupation using relative income, relative weekly hours worked, relative educational level, relative migrant stock and employment change are operationalized. The elasticities for the employment change of the industry most closely related to the occupation with respect to migration are presented via the regression coefficients. In general, the model performs well for most occupations and age groups. In most cases, the migrant stock variable is the most statistically significant variable, and almost always has the hypothesized positive sign. The results of the statistical analysis also show that the degree of significance and signs of the independent variables change with age groups within occupations. Moreover, the factors that influence inmigration are in many cases different from the factors that influence outmigration.

This study can serve as a useful information for state or regional planners who are interested in attracting or retaining persons of various occupations.

This chapter has presented the legal basis of interstate migration, and a brief survey of migration policy in other countries with an emphasis on its implications for the United States. This brief treatment of the more institutional aspects of labor mobility provides a firmer basis for analyzing this phenomenon, and implementing sounder policy. The following section will provide suggestions for further research on labor migration.

Suggestions for Additional Research

Often when a research project is undertaken it raises as many additional questions as it answers. It appears much the same with this work. The main area for further progress lies with migration modeling, and this section discusses some possibilities in this regard.

Since the main purpose of the migration forecasting model is "prediction," it is apparent that limitations still remain in the model as now formulated and implemented. The forecasting problem is not resolved by this thesis, although the studies reported here provide a substantial argument for a particular strategy of forecasting, and also provide approximations to quantitative solutions. The full strategy calls for time-series analysis at a level of geographic and structural detail not easily attained within the present statistical system of the United States. Therefore, the existence of more data for geographic areas and for alternative time periods would aid the reliability of future forecasts.

Additionally, it may be possible to incorporate more explicitly the various elements of simultaneity in a multi-equation system. Given the importance of employment change in migration forecasting, a multistage econometric model could be operationalized that could simultaneously forecast each component of regional growth. However, such a project would involve a considerably greater allocation of time and resources, and has thus far shown no greater ability to predict.

The question of cause and affect in migration analysis and employment has often been raised (Alonso, 1972). The problem has been dealt with here through the introduction of a time lag. Although other studies have varied the length of the time lag, some effort could be addressed to finding the response of potential migrants to opportunity, or the response of economic opportunity to migrants.

The structural equations used have been postulated as linear, but despite the logic of the linear form in this situation, an extended system could incorporate nonlinear relationships. One weakness of the present functional form is the unlikelihood that it will predict turning points in migration, because of its linear form, in view of the nature of the variables included, and because its sample period embraces only one turning point. The key question therefore pertains to whether the model is capable of reformulation so as to pick up turning points as they occur. One possibility is to use a nonlinear formulation and embody a group of factors which may trigger a turning point. As is the case with the other suggestions here, it is not evident the marginal improvement possible is worth the additional complexities that this may introduce.

Other studies have used gross migration data to analyze mobility (Greenwood, 1969). Although this may have added some analytic detail to the model, the restrictions such as lesser disaggregation by race and age because of the lack of data would have detracted from the usefulness of this paper for planning purposes. Perhaps further use of the Public Use Sample data would result in disaggregation by age, color, and destination and origin, thereby adding analytic refinements.

Future attempts at migration projections will be aided by new regional economic projections that are being developed by the Department of Commerce's Bureau of Economic Analysis (i.e., Series E projections). In addition, better coordination between the Bureau of Economic Analysis and the Bureau of the Census will hopefully result in homogeneous state economic areas. As more data becomes available, the substitution of age-color specific variables wherever possible for the aggregate series now used may result in at least a marginal improvement.

With respect to the occupational model, the results presented here represent a beginning to a more detailed analysis. Greater disaggregation by occupation and race would provide even more useful avenues of future research. A comparison of the factors that influence a particular three digit occupation's migration with the rest of the aggregated occupation may be useful. In the future as more data becomes available, regional migration forecasts by occupation could be operationalized.

In conclusion, migration has the effect of redistributing population over space. Its consequence in this respect can best be predicted by treating the behavioral phenomenon as though it consisted first of a decision to leave one's residence, and next to choose a destination. The models generated in this work views this process as a reaction of units of labor supply in one state to labor demand in other states. This view of regional sub-markets required considerable disaggregation, especially in connection with the quality dimensions of labor demand and supply.

APPENDIX A

APPENDIX A

(3-6) $$\Delta U_t^i = \frac{\alpha N_{t-1}^i + \Phi \, WD_{t-1}^i - \Delta L_S^i}{\varepsilon}$$ from 3

(3-7) $$\Delta L_{D_t}^i + \Delta U_t^i = \Delta L_{S_t}^i$$ substitute 5 into 1

(3-8) $$\Delta L_{D_t}^i + \frac{\alpha N_{t-1}^i + \Phi \, WD_{t-1}^i - \Delta L_{S_t}^i}{\varepsilon} = \Delta L_{S_t}^i$$ substitute 6 into 7

now $\varepsilon \, \Delta L_{D_t}^i + \alpha N_{t-1}^i + \Phi \, WD_{t-1}^i = \Delta L_{S_t}^i + \varepsilon \, \Delta L_{S_t}^i$

$$\varepsilon \, \Delta L_{D_t} + \alpha N_{t-1} + \Phi \, WD_{t-1}^i = (1+\varepsilon) \, \Delta L_{S_t}^i$$

(3-9) $$\varepsilon \, \Delta L_{D_t}^i + \alpha N_{t-1}^i + \Phi \, WD_{t-1}^i = (M_t^i + \Pi_t^i)(1+\varepsilon)$$ substitute 2 into 8

(3-10) $$\varepsilon \, (\beta \, \Delta E_{t-1}^i - \gamma \, WD_{t-1}^i - \theta \, U_{t-1}^i) + \alpha N_{t-1}^i + \Phi \, WD_{t-1}^i =$$

$$(M_t^i + \Pi_t^i)(1+\varepsilon)$$ substitute 4 into 9

now $M_t^i + \Pi_t^i = \frac{1}{1+\varepsilon} [\varepsilon \, (\beta \, \Delta E_{t-1}^i - \gamma \, WD_{t-1}^i - \theta \, U_{t-1}^i)$

$+ \alpha N_{t-1}^i + \Phi \, WD_{t-1}^i]$

(3-11) $$M_t^i = - \Pi_t^i + \left(\frac{\varepsilon\beta}{1+\varepsilon}\right) E_{t-1}^i + \left(\frac{-\gamma}{1+\varepsilon} + \Phi \quad WD_{t-1}^i\right.$$

$$- \left(\frac{\varepsilon\theta}{1+\varepsilon}\right) U_{t-1}^i + \left(\frac{\alpha}{1+\varepsilon}\right) N_{t-1}^i$$

APPENDIX B

APPENDIX B

This section will state the sources of the data and develop the appropriate algorithms used in Chapter IV. The data for inmigration and outmigration is listed on Subject Report PC2-2B is the following:

Table B-1

Illinois

Total	Inmigrants	% Inmigrants[1]	Outmigrants	% Outmigrants[1]
1965-70 eg.				
15-19	73,452	7.6	90,031	9.3
20-24	122,381	15.7	199,078	19.1
25-29	113,828	16.2	110,686	15.8
-				
-				
Negro				
15-19	8,551	6.5	6,286	4.8
20-24	15,578	15.9	9,680	9.9
25-29	9,763	10.9	7,271	8.1
-				
-				
1955-60		% Inmigrants[2]		% Outmigrants[2]
Total				
15-19	61,162	9.1	67,403	10.0
20-24	95,703	17.2	101,063	18.2
25-29	93,024	15.9	84,184	14.4
-				
-				
Nonwhite Male				
15-19	3,316	11.0	2,208	7.3
20-24	6,198	22.3	4,009	14.4
25-29	5,373	16.5	2,845	8.8
-				
-				
Nonwhite Female				
15-19	4,218	12.3	1,520	4.4
20-24	7,863	21.5	2,550	7.0
25-29	5,133	13.1	2,812	7.2
-				
-				

[1] based on total reporting on 1965 residence

[2] based on total reporting on 1955 residence

1) $$\frac{TI/OM_c^i}{\%TI/OM_c^i} = TP_c^i$$

2) $$\frac{NI/OM_c^i}{\%NI/OM_c^i} = NP_c^i$$

3) $TP_c^i - NP_c^i = WP_c^i$ from 1 and 2

4) $TI/OM_c^i - NI/OM_c^i = WI/OM_c^i$

5) $$\frac{WI/OM_c^i}{WP_c^i}$$ from 3 and 4

where

TI/OM = total in/out migration

%TI.OM = percent total in/out migration

NI/OM = nonwhite in/out migration

%NI/OM = percent nonwhite in/out migration

WP = white population

WI/OM = white in/out migration

TP = total population

i = designated state

c = designated age or sex cohort

For the following states no Negro five year population data for 1965 exists: Hawaii, Wyoming, Montana, Maine, Idaho, New Hampshire, Utah, Vermont, North Dakota, New Mexico, Alaska, and South Dakota. Therefore, 1965 population was derived in the following manner:

$$NP_c^{1965} = \frac{NP_{c-1}^{1960} + NP_{c+1}^{1970}}{2}$$

where NP = Negro population size

c-1 = the five year cohort immediately preceding c

c+1 = the five year cohort immediately following c

The labor-force population data for the period 1955-60 and 1965-70 was obtained from the Bureau of the Census publication--Current Population Reports P-25 #151, February 11, 1957, and General Population Characteristics, 1960, Final Report PC(1)-B for each State. For the period 1965-70 the data used was Current Population Reports, P-25, #332, March 23, 1966, and Current Population Reports, P-25, #500, May 1973. Net migration data was obtained from Subject Report PC2-2B Mobility for States and the Nation, Issued June 1973; Table 59.

The employment data was obtained for the following years 1954, 1959, 1964, and 1969. For each data year the employees on payrolls of nonagricultural establishments by state, and farm employment by state, were summed (Manpower Report of the President, 1973; Agricultural Statistics, 1970; 1965; 1961; 1958).

Data for aid to dependent children by state for the years 1959 and 1969 was obtained through the Statistical Abstract of the United States for 1960 and 1970. Relative per capita income data for 1959 and 1969 by state was obtained from the OBERS projections of economic activity in the U.S., Volume five. Unemployment rates for 1954, 1959, 1964, and 1969 was gathered from the Manpower Report of the President, 1974 and 1963.

The data used as past migration rates for the 1955-60 dependent variable observations were obtained from a special report from the 1940 Census, Internal Migration 1935 to 1940, Age of Migrants. Since there is no appropriately aggregated 1935 population by state obtainable from the data presented or special reports, the 1940 population for each cohort was used as a proxy. In addition, the age disaggregation for some cohorts was not the same for the 1935-40 data as for the 1955-60 data, thus, interpolation was necessary to obtain the 40-49 and 50-64 age groups. Moreover, nonwhite data was only available for approximately one-half of the states. Therefore, those states for which no nonwhite 1935-40 data exists 1955-60 nonwhite data was substituted.

The data for mean January temperature for the principal city in the state was obtained from The Weather Handbook, 1963. The mean high and low temperature for that city during the month was averaged.

APPENDIX C

COMPUTER PROGRAMS AND DATA OUTPUT

1) U-STAT PROGRAM
2) MIGRATION PROJECTION RATES

```
STMT LEVEL NEST
   1                    U_STAT: PROC OPTIONS(MAIN);
                      /*  THIS PROGRAM IS THE DEVELOPMENT OF THEIL'S U STATISTIC (ITS ALGOR
                    ITHM) TO BE USED AS A TEST OF THE FORECASTING ABILITY OF A PARTICULAR M
                    ODEL.        */
                        /*    THE VARIABLE (A) REPRESENTS THE N DIMENSIONAL VECTOR OF ACTUAL
                    OBSERVATIONS OF THE DEPENDENT VARIABLE.  THE N DIMENSIONAL VECTORS (R)
                    AND (PR) REPRESENT THE PREDICTED VALUES FROM THE USE OF REGRESSION AND
                    PAST RATES METHODS RESPECTIVELY ON THE MODEL.         */
                                                   /**/
                        /*    COMPARISONS BETWEEN U STATISTICS COMPUTED FOR (R) AND (PR) WIL
                    L BE MADE TO DETERMINE WHICH IS SIGINIFICANTLY BETTER.            */
   2       1              DCL NAMES(15) CHAR(13) INIT((13)' ');
   3       1             DCL(UEA,UERA)(2) FLOAT(10) INIT((2)0);
   4       1             DCL (R,PR)(2,14) FLOAT(10) INIT((28)0);
   5       1             DCL A(2,14) FIXED DEC(6,0) INIT((28)0);
   6       1             DCL AX(4,10) FIXED DEC(6,0) INIT((40)0);
   7       1             DCL WHITE(2,7) FIXED DEC(6,0) INIT((14)0);
   8       1            DCL N FIXED DEC (3) INIT(14);
   9       1             DCL (I,J,II,JJ) FIXED DEC INIT(0);
  10       1            DCL(SUMRA,SUMPRA,SUMA,SUMR,SUMPR)(2) FLOAT(15) INIT((2)0);
  11       1            DCL(AVERA,AVEPRA,AVEA,AVER,AVEPR)(2) FLOAT(10) INIT((2)0);
  12       1            DCL (SQRTRA,SQRTPRA,SQRTA,SQRTR,SQRTPR)(2) FLOAT(10) INIT((2)0);
  13       1             DCL USTAT(15,4) FLOAT(10) INIT((60)0);
  14       1              DCL STARS CHAR(59) INIT((59)'*');
  15       1            GET EDIT (NAMES)(COL(1),A(13));
  16       1            DO JJ=1 TO 15;
  17       1    1        GET EDIT(R,PR) (COL(1),(7)(F(10,2)));
  18       1    1          GET EDIT(AX) (COL(5),(5)(X(1),F(6)),(5)(F(6)));
  19       1    1       PUT LIST(R,PR,AX);
                        /*    CONSOLIDATE ANCILLARY AGE GROUPS       */
  20       1    1       DO I=1 TO 4;
  21       1    2       AX(I,6)= AX(I,6) + AX(I,7);
  22       1    2       AX(I,7)= 0;
  23       1    2       AX(I,7) = AX(I,8) + AX(I,9) + AX(I,10);
  24       1    2       END;
  25       1    1       PUT SKIP LIST(AX);
                        /*      SUBTRACT  NONWHITE FROM TOTALS TO OBTAIN WHITE MIGRATION   */
  26       1    1        DO J=1 TO 7;
  27       1    2       WHITE(1,J) = AX(1,J) - AX(2,J);
  28       1    2        WHITE(2,J) = AX(3,J) - AX(4,J);
  29       1    2       END;
  30       1    1      PUT SKIP LIST(WHITE);
  31       1    1       DO J=1 TO 7;
  32       1    2       A(1,J) = WHITE(1,J);
  33       1    2       A(1,J+7) = AX(2,J);
  34       1    2       A(2,J) = WHITE(2,J);
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```
           U_STAT: PROC OPTIONS(MAIN);                                                    PAGE

 STMT LEVEL NEST

  35      1    2        A(2,J+7) = AX(4,J);
  36      1    2        END;
  37      1    1        PUT SKIP LIST(A);
  38      1    1         DO J=1 TO 2;
  39      1    2          DO I=1 TO 14;
                       /*  SUM UP THE SQUARED DEVIATIONS OF WHITE AND NONWHITE FOR BOTH
                        IN AND OUT MIGRATION       */
  40      1    3        SUMRA(J) = SUMRA(J) + (R(J,I) - A(J,I))**2;
  41      1    3        SUMPRA(J) = SUMPRA(J) + (PR(J,I)-A(J,I))**2;
                       /*  SUM UP IN AND OUT MIGRATIONS      */
  42      1    3           SUMR(J)= SUMR(J)+ (R(J,I))**2;
  43      1    3         SUMPR(J)=SUMPR(J)+ (PR(J,I))**2;
  44      1    3       END;
  45      1    2         DO I=1 TO 14;
  46      1    3        SUMA(J) = SUMA(J) + (A(J,I))**2;
  47      1    3       END;
  48      1    2       PUT LIST(SUMRA,SUMPRA,SUMA,SUMR,SUMPR);
                       /*  DIVIDE SUMS BY SAMPLE SIZE TO ARRIVE AT AVERAGES  */
  49      1    2        AVERA(J)=SUMRA(J)/N;
  50      1    2         AVEPRA(J)= SUMPRA(J)/N;
  51      1    2        AVEA(J)= SUMA(J)/N;
  52      1    2        AVER(J)= SUMR(J)/N;
  53      1    2         AVEPR(J)= SUMPR(J)/N;
  54      1    2        PUT LIST(AVERA,AVEPRA,AVER,AVEPR,AVEA);
                             /*    COMPUTE THE SQUARE ROOT OF AVERAGES      */
  55      1    2        SQRTRA(J)= SQRT(AVERA(J));
  56      1    2         SQRTPRA(J)= SQRT(AVEPRA(J));
  57      1    2        SQRTA(J)= SQRT(AVEA(J));
  58      1    2         SQRTR(J)= SQRT(AVER(J));
  59      1    2         SQRTPR(J)= SQRT(AVEPR(J));
  60      1    2       PUT LIST(SQRTRA,SQRTPRA,SQRTA,SQRTR,SQRTPR);
                        /*      COMPUTE   THE U-STATISTICS       */
  61      1    2        URA(J) =(SQRTRA(J))/(SQRTR(J)+SQRTA(J));
  62      1    2       UPRA(J) = (SQRTPRA(J))/(SQRTPR(J) + SQRTA(J));
  63      1    2        PUT LIST(URA,UPRA);
  64      1    2         END:
  65      1    1       DO I=1 TO 2;
  66      1    2        SUMRA(I) = 0:
  67      1    2       SUMPRA(I) = 0;
  68      1    2        SUMA(I) = 0;
  69      1    2        SUMR(I) = 0;
  70      1    2       SUMPR(I) = 0;
  71      1    2       END;
  72      1    1        USTAT(JJ,1)= URA(1);
  73      1    1       USTAT(JJ,2)=URA(2);
```

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STMT LEVEL NEST

 74     1    1         USTAT(JJ,3)= UPPA(1);
 75     1    1         USTAT(JJ,4)= UPPA(2);
 76     1    1        END;
                     /*          PRINT U-STATISTICS          */
 77     1                 PUT SKIP(25) EDIT('U-STATISTICS FOR IN AND OUT MIGRATION FOR SEL
                    ECTED STATES')(COL(38),A);
 78     1               PUT SKIP EDIT(STATES)(COL(37),A);
 79     1             PUT SKIP EDIT('MERGE SSINT','PAST RATES')(COL(44),A,COL(78),A);
 80     1            PUT SKIP EDIT('INMIG','OUTMIG','INMIG','OUTMIG')(COL(39),A,COL(55),A,
                    COL(73),A,COL(89),A);
 81     1              DO I=1 TO 15;
 82     1    1       PUT EDIT(NAMES(I),(USTAT(I,J) DO J=1 TO 4))(COL(15),A(13),(4)(X(7),F(
                    10,6)));
 83     1    1        END;
 84     1               END U_STAT;
```

```
          U_STAT: PROC OPTIONS(MAIN);                                                  PAGE    5

        STORAGE REQUIREMENTS.
        ----------------------

        THE STORAGE AREA FOR THE PROCEDURE LABELLED U_STAT IS 2532 BYTES LONG.

        THE PROGRAM CSECT IS NAMED U_STAT   AND IS 8264 BYTES LONG.

        THE STATIC  CSECT IS NAMED *U_STATA AND IS 1057 BYTES LONG.

   *STATISTICS*     SOURCE RECORDS =      106,PROG TEXT STMNTS =       84,OBJECT BYTES =     8264
```

```
PROGRAM NUMBER 4.
EXECUTING MATRIX PROGRAM
ADDRESS OF MEMORY WORK AREA IS 03905C.  LENGTH OF MEMORY WORK AREA IS 05428B (046161).

OUTPUT FROM MATRIX SUBPARAMETER CARD NUMBER 1.
CURRENT MATRIX OPERATION IS MOVE.
NUMBER OF ROWS =        1            NUMBER OF COLUMNS =       7            DOUBLE PRECISION            I

                1           2           3           4           5           6           7
       1     0.06454     0.14302     0.16598     0.10034     0.08002     0.04777     0.03160  White Inmigration Rates

OUTPUT FROM MATRIX SUBPARAMETER CARD NUMBER 2.
CURRENT MATRIX OPERATION IS MOVE.
NUMBER OF ROWS =        1            NUMBER OF COLUMNS =       7            DOUBLE PRECISION            I

                1           2           3           4           5           6           7
       1     0.09592     0.16674     0.13477     0.14882     0.10650     0.17335     0.04667
                                                                                                White Outmigration Rates
OUTPUT FROM MATRIX SUBPARAMETER CARD NUMBER 3.
CURRENT MATRIX OPERATION IS MOVE.
NUMBER OF ROWS =        1            NUMBER OF COLUMNS =       7            DOUBLE PRECISION            I

                1           2           3           4           5           6           7
       1     0.05917     0.16954     0.12546     0.07310     0.05052     0.02984     0.01831  Nonwhite Inmigration Rates

OUTPUT FROM MATRIX SUBPARAMETER CARD NUMBER 4.
CURRENT MATRIX OPERATION IS MOVE.
NUMBER OF ROWS =        1            NUMBER OF COLUMNS =       7            DOUBLE PRECISION            I

                1           2           3           4           5           6           7
       1     0.06501     0.10286     0.10559     0.06780     0.03681     0.02215     0.01539  Nonwhite Outmigration Rates

EXECUTE TIME FOR MATRIX PROGRAM IS 0.64 SECONDS.
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
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O_1
1975

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PRØGRAM NUMBER 4.
EXECUTING MATRIX PRØGRAM
ADDRESS ØF MEMØRY WØRK AREA IS 006000.  LENGTH ØF MEMØRY WØRK AREA IS 008800 (005888).

ØUTPUT FRØM MATRIX SUBPARAMETER CARD NUMBER 1.
CURRENT MATRIX ØPERATIØN IS MØVE.
NUMBER ØF RØWS =      1            NUMBER ØF CØLUMNS =      7          DØUBLE PRECISIØN          I

            1          2          3          4          5          6          7
   1     0.07135    0.14717    0.16546    0.09793    0.07864    0.04552    0.01901 White Inmigration Rates

ØUTPUT FRØM MATRIX SUBPARAMETER CARD NUMBER 2.
CURRENT MATRIX ØPERATIØN IS MØVE.
NUMBER ØF RØWS =      1            NUMBER ØF CØLUMNS =      7          DØUBLE PRECISIØN          I

            1          2          3          4          5          6          7
   1     0.07954    0.17885    0.20719    0.16823    0.12554    0.08251    0.05272
                                                                                   White Outmigration Rates

ØUTPUT FRØM MATRIX SUBPARAMETER CARD NUMBER 3.
CURRENT MATRIX ØPERATIØN IS MØVE.
NUMBER ØF RØWS =      1            NUMBER ØF CØLUMNS =      7          DØUBLE PRECISIØN          I

            1          2          3          4          5          6          7 Nonwhite Inmigration Rates
   1     0.06095    0.17584    0.13473    0.07871    0.05423    0.03130    0.02183

ØUTPUT FRØM MATRIX SUBPARAMETER CARD NUMBER 4.
CURRENT MATRIX ØPERATIØN IS MØVE.
NUMBER ØF RØWS =      1            NUMBER ØF CØLUMNS =      7          DØUBLE PRECISIØN          I

            1          2          3          4          5          6          7
   1     0.05778    0.11396    0.10074    0.09439    0.03821    0.02276    0.01604 Nonwhite Outmigration Rates

EXECUTE TIME FØR MATRIX PRØGRAM IS 0.31 SECØNDS.
I/Ø REQUESTS USED (LØAD,EXECUTE) IS (26,27)
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
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P_1
1975

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PROGRAM NUMBER 4.
EXECUTING MATRIX PROGRAM
ADDRESS OF MEMORY WORK AREA IS 06F000.  LENGTH OF MEMORY WORK AREA IS 008800 (005888).

OUTPUT FROM MATRIX SUBPARAMETER CARD NUMBER 1.
CURRENT MATRIX OPERATION IS MOVE.
NUMBER OF ROWS =       1            NUMBER OF COLUMNS =      7          DOUBLE PRECISION            I

             1          2          3          4          5          6          7
     1    0.05545    0.13961    0.17276    0.10799    0.08548    0.05465    0.03024 White Inmigration Rates

OUTPUT FROM MATRIX SUBPARAMETER CARD NUMBER 2.
CURRENT MATRIX OPERATION IS MOVE.
NUMBER OF ROWS =       1            NUMBER OF COLUMNS =      7          DOUBLE PRECISION            I

             1          2          3          4          5          6          7
     1    0.09417    0.19071    0.15313    0.12174    0.08248    0.06129    0.04260 White Outmigration Rates

OUTPUT FROM MATRIX SUBPARAMETER CARD NUMBER 3.
CURRENT MATRIX OPERATION IS MOVE.
NUMBER OF ROWS =       1            NUMBER OF COLUMNS =      7          DOUBLE PRECISION            I

             1          2          3          4          5          6          7   Nonwhite Inmigration Rates
     1    0.05576    0.16082    0.11007    0.05369    0.04463    0.02724    0.01278

OUTPUT FROM MATRIX SUBPARAMETER CARD NUMBER 4.
CURRENT MATRIX OPERATION IS MOVE.
NUMBER OF ROWS =       1            NUMBER OF COLUMNS =      7          DOUBLE PRECISION            I

             1          2          3          4          5          6          7
     1    0.05907    0.06735    0.11128    0.07683    0.03312    0.02206    0.01440 Nonwhite Outmigration Rates

EXECUTE TIME FOR MATRIX PROGRAM IS 0.28 SECONDS.
I/0 REQUESTS USED (LOAD,EXECUTE) IS (28,27)
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
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1980

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PROGRAM NUMBER 4.
EXECUTING MATRIX PROGRAM
ADDRESS OF MEMORY WORK AREA IS 009000.  LENGTH OF MEMORY WORK AREA IS 008800 (005888).

OUTPUT FROM MATRIX SUBPARAMETER CARD NUMBER 1.
CURRENT MATRIX OPERATION IS MOVE.
NUMBER OF ROWS =        1          NUMBER OF COLUMNS =       7           DOUBLE PRECISION              I

              1             2             3             4             5             6             7
    1      0.05495       0.13069       0.16083       0.09201       0.07779       0.04442       0.02054   White Inmigration Rates

OUTPUT FROM MATRIX SUBPARAMETER CARD NUMBER 2.
CURRENT MATRIX OPERATION IS MOVE.
NUMBER OF ROWS =        1          NUMBER OF COLUMNS =       7           DOUBLE PRECISION              I

              1             2             3             4             5             6             7
    1      0.09577       0.18931       0.19245       0.16630       0.11205       0.06005       0.05040
                                                                                                          White Outmigration Rates
OUTPUT FROM MATRIX SUBPARAMETER CARD NUMBER 3.
CURRENT MATRIX OPERATION IS MOVE.
NUMBER OF ROWS =        1          NUMBER OF COLUMNS =       7           DOUBLE PRECISION              I

              1             2             3             4             5             6             7
    1      0.05311       0.17946       0.14002       0.08124       0.05866       0.02917       0.01561   Nonwhite Inmigration Rates

OUTPUT FROM MATRIX SUBPARAMETER CARD NUMBER 4.
CURRENT MATRIX OPERATION IS MOVE.
NUMBER OF ROWS =        1          NUMBER OF COLUMNS =       7           DOUBLE PRECISION              I

              1             2             3             4             5             6             7
    1      0.05808       0.10287       0.12968       0.10894       0.03187       0.02879       0.01013
                                                                                                          Nonwhite Outmigration Rates
EXECUTE TIME FOR MATRIX PROGRAM IS 0.24 SECONDS.
I/O REQUESTS USED (LOAD,EXECUTE) IS (27,27)
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
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O_1
1980

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PRØGRAM NUMBER 4.
EXECUTING MATRIX PRØGRAM
ADDRESS ØF MEMØRY WØRK AREA IS 06B800.  LENGTH ØF MEMØRY WØRK AREA IS 00B800 (005888).

ØUTPUT FRØM MATRIX SUBPARAMETER CARD NUMBER 1.
CURRENT MATRIX ØPERATIØN IS MØVE.
NUMBER ØF RØWS =       1              NUMBER ØF CØLUMNS =       7              DØUBLE PRECISIØN              I

              1            2            3            4            5            6            7
    1      0.06610      0.13912      0.16110      0.09076      0.07564      0.04089      0.01696  White Inmigration Rates

ØUTPUT FRØM MATRIX SUBPARAMETER CARD NUMBER 2.
CURRENT MATRIX ØPERATIØN IS MØVE.
NUMBER ØF RØWS =       1              NUMBER ØF CØLUMNS =       7              DØUBLE PRECISIØN              I

              1            2            3            4            5            6            7
    1      0.10874      0.18751      0.23360      0.20796      0.14847      0.10025      0.06258
                                                                                                  White Outmigration Rates
ØUTPUT FRØM MATRIX SUBPARAMETER CARD NUMBER 3.
CURRENT MATRIX ØPERATIØN IS MØVE.
NUMBER ØF RØWS =       1              NUMBER ØF CØLUMNS =       7              DØUBLE PRECISIØN              I

              1            2            3            4            5            6            7
    1      0.05689      0.19109      0.15806      0.09237      0.06494      0.03169      0.02179  Nonwhite Inmigration Rates

ØUTPUT FRØM MATRIX SUBPARAMETER CARD NUMBER 4.
CURRENT MATRIX ØPERATIØN IS MØVE.
NUMBER ØF RØWS =       1              NUMBER ØF CØLUMNS =       7              DØUBLE PRECISIØN              I

              1            2            3            4            5            6            7
    1      0.07170      0.12056      0.12243      0.11959      0.03406      0.03213      0.01127  Nonwhite Outmigration Rates

EXECUTE TIME FØR MATRIX PRØGRAM IS 0.36 SECØNDS.
I/Ø REQUESTS USED (LØAD,EXECUTE) IS (27,27)
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
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1980

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PROGRAM NUMBER 4.
EXECUTING MATRIX PROGRAM
ADDRESS OF MEMORY WORK AREA IS 09C000.  LENGTH OF MEMORY WORK AREA IS 008800 (005988).

OUTPUT FROM MATRIX SUBPARAMETER CARD NUMBER 1.
CURRENT MATRIX OPERATION IS MOVE.
NUMBER OF ROWS =        1            NUMBER OF COLUMNS =       7            DOUBLE PRECISION               I

               1          2          3          4          5          6          7
     1      0.03892    0.12262    0.16943    0.10049    0.08784    0.05613    0.03274   White Inmigration Rates

OUTPUT FROM MATRIX SUBPARAMETER CARD NUMBER 2.
CURRENT MATRIX OPERATION IS MOVE.
NUMBER OF ROWS =        1            NUMBER OF COLUMNS =       7            DOUBLE PRECISION               I

               1          2          3          4          5          6          7
     1      0.08270    0.18514    0.13699    0.10864    0.06437    0.05340    0.03876
                                                                                       White Outmigration Rates
ØUTPUT FROM MATRIX SUBPARAMETER CARD NUMBER 3.
CURRENT MATRIX ØPERATIØN IS MØVE.
NUMBER ØF RØWS =        1            NUMBER ØF CØLUMNS =       7            DØUBLE PRECISIØN               I

               1          2          3          4          5          6          7
     1      0.04674    0.16298    0.11155    0.06362    0.04747    0.02366    0.00673   Nonwhite Inmigration Rates

ØUTPUT FRØM MATRIX SUBPARAMETER CARD NUMBER 4.
CURRENT MATRIX ØPERATIØN IS MØVE.
NUMBER ØF RØWS =        1            NUMBER ØF COLUMNS =       7            DØUBLE PRECISIØN               I

               1          2          3          4          5          6          7
     1      0.06006    0.04649    0.13669    0.09050    0.02446    0.02472    0.00884   Nonwhite Outmigration Rates

EXECUTE TIME FØR MATRIX PRØGRAM IS 0.33 SECONDS.
I/Ø REQUESTS USED (LØAD,EXECUTE) IS (29,27)
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
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OBER
1985

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PROGRAM NUMBER 4.
EXECUTING MATRIX PROGRAM
ADDRESS OF MEMORY WORK AREA IS 05F000.  LENGTH OF MEMORY WORK AREA IS 008800 (005888).

OUTPUT FROM MATRIX SUBPARAMETER CARD NUMBER 1.
CURRENT MATRIX OPERATION IS MOVE.
NUMBER OF ROWS =      1          NUMBER OF COLUMNS =      7          DOUBLE PRECISION          I

                1            2            3            4            5            6            7
      1      0.04475      0.12095      0.16139      0.09009      0.07908      0.04519      0.02420   White Inmigration Rates

OUTPUT FROM MATRIX SUBPARAMETER CARD NUMBER 2.
CURRENT MATRIX OPERATION IS MOVE.
NUMBER OF ROWS =      1          NUMBER OF COLUMNS =      7          DOUBLE PRECISION          I

                1            2            3            4            5            6            7
      1      0.09952      0.19269      0.18700      0.17649      0.11100      0.08548      0.05613   White Outmigration Rates

OUTPUT FROM MATRIX SUBPARAMETER CARD NUMBER 3.
CURRENT MATRIX OPERATION IS MOVE.
NUMBER OF ROWS =      1          NUMBER OF COLUMNS =      7          DOUBLE PRECISION          I

                1            2            3            4            5            6            7
      1      0.04532      0.18463      0.14713      0.08443      0.06344      0.02726      0.01206   Nonwhite Inmigration Rates

OUTPUT FROM MATRIX SUBPARAMETER CARD NUMBER 4.
CURRENT MATRIX OPERATION IS MOVE.
NUMBER OF ROWS =      1          NUMBER OF COLUMNS =      7          DOUBLE PRECISION          I

                1            2            3            4            5            6            7
      1      0.06511      0.08214      0.14906      0.11822      0.02564      0.04034      0.00898   Nonwhite Outmigration Rates

EXECUTE TIME FOR MATRIX PROGRAM IS 0.33 SECONDS.
I/O REQUESTS USED (LOAD,EXECUTE) IS (28,27)
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
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EXECUTING MATRIX PROGRAM
ADDRESS OF MEMORY WORK AREA IS 050800.  LENGTH OF MEMORY WORK AREA IS 0C8800 (005888).

OUTPUT FROM MATRIX SUBPARAMETER CARD NUMBER 1.
CURRENT MATRIX OPERATION IS MOVE.
NUMBER OF ROWS =        1          NUMBER OF COLUMNS =   .  7          DOUBLE PRECISION          I

               1          2          3          4          5          6          7
    1    0.06017    0.13428    0.16430    0.09138    0.07729    0.04198    0.02070  White Inmigration Rates

OUTPUT FROM MATRIX SUBPARAMETER CARD NUMBER 2.
CURRENT MATRIX OPERATION IS MOVE.
NUMBER OF ROWS =        1          NUMBER OF COLUMNS =      7          DOUBLE PRECISION          I

               1          2          3          4          5          6          7
    1    0.12303    0.19690    0.25134    0.24372    0.16435    0.11869    0.07518
                                                                                      White Outmigration Rates
OUTPUT FROM MATRIX SUBPARAMETER CARD NUMBER 3.
CURRENT MATRIX OPERATION IS MOVE.
NUMBER OF ROWS =        1          NUMBER OF COLUMNS =      7          DOUBLE PRECISION          I

               1          2          3          4          5          6          7        Nonwhite Inmigration Rates
    1    0.05112    0.20230    0.17281    0.10025    0.07263    0.03176    0.01980

OUTPUT FROM MATRIX SUBPARAMETER CARD NUMBER 4.
CURRENT MATRIX OPERATION IS MOVE.
NUMBER OF ROWS =        1          NUMBER OF COLUMNS =      7          DOUBLE PRECISION          I

               1          2          3          4          5          6          7
    1    0.06722    0.10003    0.13767    0.13128    0.02913    0.04683    0.01052  Nonwhite Outmigration Rates

EXECUTE TIME FOR MATRIX PROGRAM IS 0.33 SECONDS.
I/O REQUESTS USED (LOAD,EXECUTE) IS (29,27)
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
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P_1
1985

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PROGRAM NUMBER 4.
EXECUTING MATRIX PROGRAM
ADDRESS OF MEMORY WORK AREA IS 0588C0.  LENGTH ØF MEMØRY WØRK AREA IS 008800 (005885).

OUTPUT FROM MATRIX SUBPARAMETER CARD NUMBER 1.
CURRENT MATRIX ØPERATIØN IS MØVE.
NUMBER ØF RØWS =      1            NUMBER ØF CØLUMNS =      7           DØUBLE PRECISIØN              I

             1           2           3           4           5           6           7
    1     0.02260     0.10450     0.16663     0.09514     0.09058     0.05787     0.03730   White Inmigration Rates

OUTPUT FROM MATRIX SUBPARAMETER CARD NUMBER 2.
CURRENT MATRIX ØPERATIØN IS MØVE.
NUMBER ØF RØWS =      1            NUMBER ØF CØLUMNS =      7           DØUBLE PRECISIØN              I

             1           2           3           4           5           6           7
    1     0.07108     0.18237     0.10051     0.08210     0.03762     0.03925     0.03194
                                                                                           White Outmigration Rates
OUTPUT FROM MATRIX SUBPARAMETER CARD NUMBER 3.
CURRENT MATRIX ØPERATIØN IS MØVE.
NUMBER ØF RØWS =      1            NUMBER ØF CØLUMNS =      7           DØUBLE PRECISIØN              I

             1           2           3           4           5           6           7
    1     0.03585     0.16029     0.10588     0.05870     0.04621     0.01960    -0.00014   Nonwhite Inmigration Rates

OUTPUT FROM MATRIX SUBPARAMETER CARD NUMBER 4.
CURRENT MATRIX ØPERATIØN IS MØVE.
NUMBER ØF RØWS =      1            NUMBER ØF CØLUMNS =      7           DØUBLE PRECISIØN              I

             1           2           3           4           5           6           7
    1     0.05671     0.01892     0.15884     0.09438     0.01460     0.03106     0.00695   Nonwhite Outmigration Rates

EXECUTE TIME FØR MATRIX PRØGRAM IS 0.31 SECØNDS.
I/Ø REQUESTS USED (LØAD,EXECUTE) IS (26,27)
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
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APPENDIX D

COMPUTER PROGRAM FOR PUBLIC USE SAMPLE DATA

FORMULATION AND DATA IMPLEMENTATION
BY MORRIS M. KLEINER

COMPUTER IMPLEMENTATION
BY FRANK KNOWLES AND MARTHA ADES

```
             /*THIS PROGRAM READS DATA FROM THE PUBLIC USE SAMPLE TAPES(RECOPIED */
             /*CENSUS TAPES-STATE 2PCT),INCREMENTS VARIOUS CTRS(SOME RESET */
             /* AFTER EACH STATE,OTHERS CARRIED FROM RUN TO RUN).STATE MEANS ARE */
             /* CALCULATED AFTER STATE DATA READ.MEANS WRITTEN ON INFO.DATA NEEDED*/
             /* FOR NEXT RUN WRITTEN ON TEMPNEW.DATA NEEDED FROM LAST RUN READ */
             /*FROM TEMPOLD. FOR RUN2,A SETUP AND DD CARD IS ADDED FOR TEMPNEW. */
             /*FOR ALL RUNS AFTER 2ND,THE VOL=SER NUMBERS,MMK011,MMK012 ARE */
             /*SWITCHED ON SETUP AND DD CARDS. THUS OUTPUT OF LAST RUN IS INPUT */
             /* TO THIS RUN-INPUT OF LAST RUN IS OVERWRITTEN BY OUTPUT OF THIS RUN*/
             /* ALSO, A DIFF INPUT CENSUS TAPE IS USED FOR EACH OF THE NINE RUNS. */
             /*THE TEMPNEW FROM RUN1 BECOMES TEMPOLD FOR RUN2. ON RUN2,MMK011 = */
             /* TEMPOLD,MMK012=TEMPNEW. THUS ON SETUP & DD CARDS, DSN & SER# MUST */
             /* BE CHANGED. ALL RUNS AFTER 2ND,DISP=(OLD,KEEP) ON TEMPOLD & */
             /* TEMPNEW. ON ALL RUNS AFTER 1ST,DISP=MOD ON INFO. */

   1         (SIZE): START: PROC OPTIONS(MAIN);

             /* REC=NUMBER OF RECORD TO BE READ IN */

   2         DCL REC FIXED(7) INIT(0);

             /* BH=CTR OF BAD HOUSE REC. P=NUM OF REC SKIPPED TIL GOOD HOUSE REC. */

   3         DCL (BH,P) FIXED(2) INIT(0);

             /* LOOP VARIABLES */

   4         DCL (A,B,I,J,L,M) FIXED BIN (8);

             /* HOUSE REC ARE READ INTO STRUCTURE HOUSE. */

   5         DCL
                1 HOUSE,2 SAMPLE CHAR(1),2 DUM1 CHAR(5),2 NOWSTATE CHAR(2),2 DUM2
                         CHAR(3),2 NUM CHAR(2),2 DUM3 CHAR(106),2 TYPE CHAR(1);

             /* PERSON RECORDS ARE READ INTO STRUCTURE PERSON. */

   6         DCL
                1 PERSON,2 DUM1 CHAR(5),(2 SEX,2 COLOR,2 DUM2) CHAR(1),2 AGE CHAR(3)
                          ,2 DUM3 CHAR(2),2 PLACE CHAR(1),(2 BIRTH,2 GRADE) CHAR(2),
             2 DUM4 CHAR(3),2 LBS CHAR(1),2 DUM5 CHAR(1),2 CURIND CHAR(3),2 PCC CHAR
             (3),         (2 DUM6,2 EMP) CHAR(1),2 DUM7 CHAR(17),2 PUBASSIST CHAR(3),
                          2 DUM8 CHAR(4),2 INCOME CHAR(3),2 POVCUT CHAR(1), 2 DUM9
             CHAR(25), 2 THENSTATE CHAR(2),2 IND5  CHAR(3),2 PCC5 CHAR(3),
             2 DUM11 CHAR(27),2 TYPE CHAR(1);

             /* WORKING VAR USED IN MAIN PROG THAT ARE NOT RESET BY STATE CALC */

             /* NUM=# PERSONS IN HOUSEHOLD NOT YET PROCESSED(HOUSE.NUM) */

             /* NOWSTATE=STATE OF HOUSEHOLD (CHAR)     OCC=OCCUPATION CAT. */

             /* OCC5=1965 OCC CAT.  IOCC=USED IN CAL OF OCC,OCC5. */

             /* H=HRS WORKED. PINC=PERSON INCOME. AGE=AGE. PAS=AMT PUB ASSIST. */
             /* PV=RATIO FAMILY INC TO POV LEV. PINC1,PAS1=USED TO CAL PINC,PAS. */  00571
                                                                                    00581
             /* K1=STATE OF RES 1970(INTEGER). K2=STATE OF RES 1965(INTEGER). */    00591
                                                                                    00601
             /*AGEROW=AGE CAT. SEXCOL=SEX CAT. COLORCOL=COLOR CAT. */               00611
             /* THESE ARE ROW,COL NOS. FOR IN,OUT, TABLES. */                       00621
             /* ID=INDUSTRY CAT.  ID1=USED TO CAL ID. */                            00631
                                                                                    00641
    7        DCL                                                                    00651
               NUM FIXED(3) INIT(0),NOWSTATE CHAR(2) INIT('00'),                    00661
             OCC FIXED(2),OCC5 FIXED (2),TOCC FIXED(3),                             00671
                   H FIXED(2),PINC FIXED(5),AGE FIXED(3),PAS FIXED(5),PV FIXED(3,2 00681
               ),(K1,K2)FIXED(2),    PINC1 FIXED(3), PAS1 FIXED(3),                 00691
             (AGEROW,SEXCOL,COLORCOL) FIXED(1), ID FIXED(1), ID1 FIXED(3);          00701
                                                                                    00711
             /* STATE CTRS(ARRAYS INDEXED BY OCC) RESET BY PROC STATE_CAL: */       00721
                                                                                    00731
             /* BCTR=# PERSONS NOT SPEC STATE-65(THESE COUNTED BUT NOT PROCESSED).*/ 00741
                                                                                    00751
             /* TOTAL=# IN OCC. TOTW=NUMBER'AT WORK'. (HRS CAL ONLY FOR THESE) */   00761
                                                                                    00771
             /* HRS=HRS WORKED. INC=TOT PERSON INC. GRADE=HIGH GRADE ATTENDED. */   00781
                                                                                    00791
             /* BIRTH=# BORN OUT STATE(BIRTH STATE NOT SPEC ASSUMED=NOWSTATE) */    00801
                                                                                    00811
             /* PUBCTR=# REC PUB ASSIST. PUB=AMT PUB ASSIST. POV=INC/POV LEV. */    00821
                                                                                    00831
    8        DCL                                                                    00841
             (BCTR(12),TOTAL(12),TOTW(12)) FIXED(6) INIT((12)0),                    00851
             INC(12) FIXED(11) INIT((12)0),GRADE(12) FIXED(8) INIT((12)0),          00861
             HRS(12) FIXED(8) INIT((12)0),BIRTH(12) FIXED(6) INIT((12)0),           00871
             PUB(12) FIXED(11) INIT((12)0),                                         00881
             PUBCTR(12) FIXED(5) INIT((12)0), POV(12) FIXED(8,2) INIT((12)0);       00891
                                                                                    00901
             /* NAT CTRS-READ-TEMPOLD-TRANSFER_IN-WRITTEN-TEMPNEW-TRANSFER_OUT. */  00911
                                                                                    00921
    9        DCL                                                                    00931
                             NTOT(12) FIXED(8),  NTOTW(12) FIXED(8),  NINC(12)      00941
                           FIXED(13),  NGRADE(12) FIXED(10),  NBIRTH(12) FIXED      00951
                           (8),  NHRS(12) FIXED(10), NPUB(12) FIXED(13),            00961
                             NPUBCTR(12) FIXED(8),  NPOV(12) FIXED(10,2);           00971
                                                                                    00981
             /* S(I)=CHAR CODE(AS ON UNIT) OF ITH STATE IN ALPHABETICAL ORDER. */   00991
                                                                                    01001
   10          DCL S(51) CHAR(2)                                                    01011
                   INIT('01','02','04','05','06','08','09','10','11','12','13','15', 01021
                        '16','17','18','19','20'.'21','22','23','24','25','26','27', 01031
                        '28','29','30','31','32','33','34','35','36','37','38','39', 01041
                        '40','41','42','44','45','46','47','48','49','50','51','53', 01051
                        '54','55','56');                                            01061
                                                                                    01071
             /* TABLE=STATE MEANS CAL BY STATE_CAL EXCEPT FOR: */                   01081
             /* IN(I,J)=IN MIGRATION TABLE BY AGE I-SEX OR COLOR J, AND */          01091
             /* PIN(I)=TOTAL NUMBER IMMIGRANTS IN ITH AGE CATEGORY. */              01101
             /* IN,PIN UPDATED DURING MAIN PROG. PIN USED-CAL PCTS AT PRINT TIME. */ 01111
             /* TABLE( ) IS INDEXED BY OCC IS WRITTEN 6. STATE_CAL AS ONE REC ON */ 01121
             /* INFO. TABLE.REC='TABLE',TABLE.STAT=STATE CODE(AS ON UNIT). EACH */  01131
```

```
               /* REC(ONE STATE) ON INFO IS READ BACK IN BY NAT_CAL & PRINT_OUT. */

  11           DCL
                  1 TABLE(12),2 REC CHAR(5),2 STAAT CHAR(2),
                  2 UOTAL FIXED(6),2 PCTEXL FIXED(3),2 INCOME FIXED(5),
               2 LRS FIXED(2), 2 HRADE FIXED(2),2 PCT_BORN_OUT FIXED(3),
               2 PJBASSIST FIXED(6),2 PUB_PCT FIXED(3),2 PCV_R FIXED(5,2),
               2 IN(5,6) FIXED(6),2 PIN(4) FIXED(5);

               /* OOOUT(I,J,A,B)=#-STATE I-65(DIFF IN 70),OCC J-70,AGE A,COLOR B. */

  12           DCL OOOUT(51,12,5,6) FIXED(6);

               /* IND70(I,J)=#-STATE I-70,INDUSTRY J-70. */

               /* IND65(I,J)=#-STATE I-65(DIFF IN 70),INDUSTRY J-65. */

               /* THENOCC(I,J)=#-STATE I-65(DIFF IN 70),OCC J-65. */

  13           DCL
                  IND70(51,7) FIXED(6),
                  IND65(51,7) FIXED(6),    THENOCC(51,12) FIXED(6);

               /* TRANSFER-IN READS FROM TEMPOLD: OOOUT,NAT CTRS,IND70,IND65, */
               /*AND THENOCC. ALL RUNS AFTER 1ST-FIRST PROC EXEC.NOT EXEC ON 1ST RUN*/

  14           TRANSFER_IN: PROC;

                          /* USED TO TRANSFER OOOUT */

  15           DCL
               1 POOUT,
                  2 REC CHAR(5), 2 STAAT CHAR(2),
                  2 OUT(12,5,6) FIXED(6);

               /* USED TO TRANSFER NAT CTRS BEGINNING WITH NICT,ENDING WITH NPOV */

  16           DCL
                  1 STUFF,2 REC CHAR(5), 2 STAAT CHAR(2),
               2 S1(12) FIXED(8),2 S2(12) FIXED(8),
               2 S3(12) FIXED(13), 2 S4(12) FIXED(10),
               2 S5(12) FIXED(8), 2 S6(12) FIXED(10),
               2 S7(12) FIXED(13), 2 S8(12) FIXED(8),
               2 S9(12) FIXED(10,2), 2 DUM CHAR(816);

               /* USED TO TRANSFER IDN70,IND65, AND THENOCC */

  17           DCL
               1 IND,
                  2 REC CHAR(5), 2 STAAT CHAR(2),
               2 P(12) FIXED(6),
               2 G(7) FIXED(6), 2 K(7) FIXED(6), 2 DUM CHAR(1336);

                                 /* TRANSFER OOOUT */

  18              DO I=1 TO 51;
  19          READ FILE(TEMPOLD) INTO(PCOUT);                                01711
                                                                             01721
  20          POOUT(I,*,*,*)=PCOUT.CUT(*,*,*);                               01731
  21          END;                                                           01741
                                                                             01751
                          /* TRANSFER NAT CTRS */                            01761
                                                                             01771
  22          READ FILE(TEMPOLD) INTO(STUFF);                                01781
                                                                             01791
  23          NTCT=S1;  NTOTW=S2;  NINC=S3;  NGRADE=S4;  NBIRTH=S5; NHRS=S6; 01801
  29          NPUB=S7;  NPUBCTR=S8;  NPOV=S9;                                01811
                                                                             01821
                         /* TRANSFER  IND70,IND65,THENOCC */                 01831
                                                                             01841
  32          DO I=1 TO 51;                                                  01851
                                                                             01861
  33          READ FILE(TEMPOLD) INTO(IND);                                  01871
                                                                             01881
  34          THENOCC(I,*)=P(*);                                             01891
  35          IND65(I,*)=G(*);                                               01901
  36          IND70(I,*)=K(*);                                               01911
  37          END;                                                           01921
                                                                             01931
  38          RETURN;                                                        01941
  39          END TRANSFER_IN;                                               01951
                                                                             01961
              /* PROC Z USES S TO CALCULATE STATE(INTEGER) FROM STATE(CHAR). */ 01971
                                                                             01981
  40          DCL Z RETURNS(FIXED(2));                                       01991
                                                                             02001
  41          Z: PROC (C) RETURNS(FIXED(2));                                 02011
                                                                             02021
  42            DCL C CHAR(2), L FIXED(2);                                   02031
  43          DCL K FIXED BIN (8);                                           02041
                                                                             02051
  44            DO  K=1 TO 51;                                               02061
  45              IF C=S(K) THEN L=K;                                        02071
  47            END;                                                         02081
  48            RETURN(L);                                                   02091
  49          END Z;                                                         02101
                                                                             02111
              /*STATE_CAL CAL STATE MEANS,RESETS STATE CTRS,UPDATES NOWSTATE. */ 02121
              /* TABLE IS WRITTEN ON INFO AS ONE REC-STATE(CHAR)IS IN TABLE.STAAT */ 02131
                                                                             02141
  50          STATE_CAL: PROC;                                               02151
                                                                             02161
              /*CALCULATE STATE MEANS-PRINTED ABOVE IN-TABLE-AND SUM IN-TABLE COLS.*/ 02171
                 /* IF STATEMENTS ARE PUT IN TO AVOID ZERODIVIDE. */         02181
                                                                             02191
  51                                 DO   I=1 TO 12;                         02201
  52          IF TOTAL(I)=0 THEN GOTO SKIP;                                  02211
  54          TABLE(   I).UCTAL=TOTAL(I);                                    02221
  55          TABLE(   I).PCTEXL=(BCTR(I)/(BCTR(I) + TOTAL(I))   )*100;      02231
  56          TABLE(   I).INCOME=INC(I)/TOTAL(I);                            02241
  57          IF TOTW(I)=0 THEN TABLE(I).LRS=0;                              02251
  59          ELSE                                                           02261
  59          TABLE(   I).LPS=HRS(I)/TOTW(I);                                02271
```

```
 60             TABLE(    I).HRADE=GRADE(I)/TOTAL(I);
 61             TABLE(    I).PCT_BORN_OUT=(BIRTH(I)/TOTAL(I))*100;
 62             IF PUBCTR(I)=0 THEN TABLE(I).PUBASSIST=0;
 64             ELSE
 64             TABLE(    I).PUBASSIST=PUB(I)/PUBCTR(I);
 65             TABLE(    I).PUB_PCT=(PUBCTR(I)/TOTAL(I))*100;
 66             TABLE(    I).POV_R=POV(I)/TOTAL(I);
 67             TABLE(    I).IN(*,3)=TABLE(    I).IN(*,2)+TABLE(    I).IN(*,1);
 68             TABLE(    I).IN(*,6)=TABLE(    I).IN(*,5)+TABLE(    I).IN(*,4);
 69                                                DO  M=1 TO  4;
 70             TABLE(    I).IN(5,*)=TABLE(    I).IN(5,*)+TABLE(    I).IN(M,*);
 71                                                END;
 72             SKIP:            END;

                     /* TRANSFER TABLE */

 73                  DO J= 1 TO 12;
 74             TABLE(J).REC= 'TABLE';  TABLE(J).STAAT=NOWSTATE;
 76                  END;
 77             WRITE FILE (INFO) FROM (TABLE);

                    /* RESET STATE CTRS */

 78             BCT3=0;  TOTAL=0;  INC=0;  GRADE=0;  HRS=0;  PUB=0;  PUBCTR=0;
 85                   BIRTH=0;  POV=0;  TOTW=0;  TABLE=0;

                    /* SET NOWSTATE =STATE OF RESIDENCE OF LAST HOUSE REC READ */

 89                NOWSTATE=HOUSE.NOWSTATE;

 90                RETURN;
 91                END  STATE_CAL;

                /*AT END OF RUN,TRANSFER_OUT WRITES DATA THAT TRANSFER_IN  WILL READ.*/
                /*AN ARRAY REP 51 STATES IS TRANSFERRED BY A STRUCTURE REP ONE STATE.*/
                /* TRANSFER_OUT IS CALLED BY NAT_CAL(BEFORE NAT_TRANS IS CALLED.)*/
                /*TRANSFER_OUT WRITES OCOUT ON TEMPNEW-51 REC-PCOUT IS STRUCTURE USED*/
                /*       TO TRANSFER. PCOUT.REC='PCOUT',PCOUT.STAAT=STATE CODE(AS ON */
                /* UNIT). THEN TRANSFER_OUT WRITES ONE REC OF NAT CTRS USING */
                /* STRUCTURE STUFF. STUFF.REC='STUFF',STUFF.STAAT=STATE CODE(AS ON */
                /* UNIT). THEN TRANSFER_OUT WRITES 51 REC OF STRUCTURE IND(IND/0, */
                /* IND65,THENDCC). IND.REC='IND',IND.STAAT=STATE CODE(AS ON UNIT). */

 92             TRANSFER_OUT:  PROC;

                          /* USED TO TRANSFER OCOUT */

 93             DCL
                1 PCOUT,
                  2 REC CHAR(5), 2 STAAT CHAR(2),
                  2 OUT(12,5,6) FIXED(6);

                /* USED TO TRANSFER NAT CTRS BEGINNING WITH NTOT,ENDING WITH NPOV */

 94             DCL
                  1 STUFF,2 REC CHAR(5), 2 STAAT CHAR(2),
                  2 S1(12) FIXED(8),2 S2(12) FIXED(8),                                         02851
                  2 S3(12) FIXED(13), 2 S4(12) FIXED(10),                                      02861
                  2 S5(12) FIXED(8), 2 S6(12) FIXED(10),                                       02871
                  2 S7(12) FIXED(13), 2 S8(12) FIXED(8),                                       02881
                  2 S9(12) FIXED(10,2), 2 DUM CHAR(816);                                       02891
                                                                                               02901
                  /* USED TO TRANSFER IDN70,IND65, AND THENOCC */                              02911
                                                                                               02921
     95           DCL                                                                          02931
                  1 IND,                                                                       02941
                     2 REC CHAR(5), 2 STAAT CHAR(2),                                           02951
                  2 P(12) FIXED(6),                                                            02961
                  2 G(7) FIXED(6), 2 K(7) FIXED(6), 2 DUM CHAR(1336);                          02971
                                                                                               02981
                                  /* TRANSFER OCOUT */                                         02991
                                                                                               03001
     96              DO I=1 TO 51;                                                             03011
                                                                                               03021
     97           PCOUT.REC='PCOUT';   PCOUT.STAAT=S(I);                                       03031
     99           PCOUT.OUT(*,*,*)=OCOUT(I,*,*,*);                                             03041
    100           WRITE FILE(TEMPNEW) FROM(PCOUT);                                             03051
    101              END;                                                                      03061
                                                                                               03071
                                  /* TRANSFER NAT CTRS */                                      03081
                                                                                               03091
    102           STUFF.REC='STUFF';            STUFF.STAAT='00';                              03101
    104           S1=NTOT;   S2=NTOTW;   S3=NINC;   S4=NGRADE;   S5=NBIRTH;   S6=NHRS;         03111
    110           S7=NPUB;   S8=NPUBCTR;   S9=NPOV;                                            03121
                                                                                               03131
    113           WRITE FILE(TEMPNEW) FROM (STUFF);                                            03141
                                                                                               03151
                                 /* TRANSFER  IND70,IND65,THENOCC */                           03161
                                                                                               03171
    114           DO I=1 TO 51;                                                                03181
    115           IND.REC='  IND';   IND.STAAT=S(I);                                           03191
    117           P(*)=THENOCC(I,*);                                                           03201
    118           G(*)=IND65(I,*);                                                             03211
    119           K(*)=IND70(I,*);                                                             03221
                                                                                               03231
    120           WRITE FILE(TEMPNEW) FROM(IND);                                               03241
                                                                                               03251
    121           END;                                                                         03261
                                                                                               03271
    122           RETURN;                                                                      03281
    123           END TRANSFER_OUT;                                                            03291
                                                                                               03301
                  /* NAT_CAL CAL STATE/NAT RATIOS,WRITES RESULTS ON TEMPNEW,AND PRINTS.*/      03311
                                                                                               03321
    124           NAT_CAL: PROC;                                                               03331
                                                                                               03341
                              /* I=STATE(INTEGER) NOW BEING PROCESSED */                       03351
                                                                                               03361
    125           DCL I FIXED(2);                                                              03371
                                                                                               03381
                           /* TABLR CONTAINS ALL STATE/NAT RATIOS. */                          03391
                                                                                               03401
    126           DCL                                                                          03411
```

```
                  1 TABLR(51,12),                                                        03421
                  2 INCOME_R FIXED(5,2),2 LRS_R FIXED(5,2),2 HRADE_R FIXED(5,2),         03431
                  2 PCT_R FIXED(5,2),2 PUBASSIST_R FIXED(5,2),2 PUB_PCT_R FIXED(5,2),    03441
                  2 POV_RR FIXED(5,2);                                                   03451
                                                                                         03461
                       /* TABLE_R IS USED TO TRANSFER TABLR IN PROC NAT_TRANS. */        03471
                                                                                         03481
     127          DCL                                                                    03491
                  1 TABLE_R,                                                             03501
                  2 REC CHAR(5),2 STAAT CHAR(2),                                         03511
                  2 INCOME_R(12) FIXED(5,2),2 LRS_R(12) FIXED(5,2),                      03521
                  2 HRADE_R(12) FIXED(5,2),2 PCT_R(12) FIXED(5,2),                       03531
                  2 PUBASSIST_R(12) FIXED(5,2),2 PUB_PCT_R(12) FIXED(5,2),               03541
                  2 POV_PR(12) FIXED(5,2),2 DUM CHAR(1188);                              03551
                                                                                         03561
                  /*NAT_TRANS WRITES TEMPNEW FROM TABLE_R-AFTER TRANSFER_OUT IS CALLED.*/ 03571
                  /*NAT_TRANS WRITES 51 REC. TABLE_R.REC='TABLR'. TABLE_R.STAAT=STATE */ 3572
                  /* CODE AS ON UNIT. */                                                 3573
                                                                                         03581
     128          NAT_TRANS: PROC;                                                       03591
                                                                                         03601
     129          DO I=1 TO 51;                                                          03611
     130          TABLE_R.REC='TABLR';  TABLE_R.STAAT= S(I);                             03621
     132          DO J=1 TO 12;                                                          03631
     133          TABLE_R.INCOME_R(J)=TABLR(I,J).INCOME_R;                               03641
     134          TABLE_R.LRS_R( J)=TABLR(I,J).LRS_R;                                    03651
     135          TABLE_R.HRADE_R(J)=TABLR(I,J).HRADE_R;                                 03651
     136          TABLE_R.PCT_R(J)=TABLR(I,J).PCT_R;                                     03671
     137          TABLE_R.PUBASSIST_R( J)=TABLR(I,J).PUBASSIST_R;                        03681
     138          TABLE_R.PUB_PCT_R( J)=TABLR(I,J).PUB_PCT_R;                            03691
     139          TABLE_R.POV_RR( J)=TABLR(I,J).POV_RR;                                  03701
     140          END;                                                                   03711
     141          WRITE FILE(TEMPNEW) FROM(TABLE_R);                                     03721
     142          END;                                                                   03731
     143          RETURN;                                                                03741
     144          END NAT_TRANS;                                                         03751
                                                                                         03761
                  /*FOR EACH STATE(EACH REC ON INFO) AND OCC, PRINT_OUT PRINTS:  */      03771
                  /*STATE MEANS,IN-TABLE,OUT-TABLE (IN THAT ORDER).PCT COL OF EACH */    03781
                  /* TABLE IS CALCULATED BEFORE MATRIX IS CALLED TO PRINT THE TABLE */   03791
                  /*AFTER LAST REC ON INFO,START READING OVER AGAIN FROM INFO TO  */     03801
                  /* PRINT INDUSTRY FIGURES. */                                          03811
                                                                                         03821
     145          PRINT_OUT: PROC;                                                       03831
                                                                                         03841
                                /* STATE=NAME OF STATE--FOR PRINTING */                  03851
                                                                                         03861
     146          DCL STATE(51) CHAR(20) VAR                                             03871
                    INIT('ALABAMA','ALASKA','ARIZONA','ARKANSAS',                        03872
                     'CALIFORNIA','COLORADO','CONNECTICUT','DELAWARE','DISTRICT OF COLUM 03881
                  BIA',          'FLORIDA','GEORGIA','HAWAII','IDAHO','ILLINOIS','INDIANA' 03891
                     ,'IOWA','KANSAS','KENTUCKY','LOUISIANA','MAINE','MARYLAND',         03901
                     'MASSACHUSETTS','MICHIGAN','MINNESOTA','MISSISSIPPI','MISSOURI',    03911
                     'MONTANA','NEBRASKA','NEVADA','NEW HAMPSHIRE','NEW JERSEY',         03921
                     'NEW MEXICO','NEW YORK','NORTH CAROLINA','NORTH DAKOTA','OHIO',     03931
                     'OKLAHOMA','OREGON','PENNSYLVANIA','RHODE ISLAND','SOUTH CAROLINA', 03941
                     'SOUTH DAKOTA','TENNESSEE','TEXAS','UTAH','VERMONT','VIRGINIA',     03951
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                'WASHINGTON','WEST VIRGINIA','WISCONSIN','WYOMING');                03961
                                                                                    03971
                         /* JOB=NAME OF OCCUPATION--FOR PRINTING */                 03981
                                                                                    03991
 147        DCL JOB(12) CHAR(44) VAR                                                04001
            INIT('PROFESSIONAL, TECHNICAL, AND KINDRED WORKERS',                    04011
                'MANAGERS AND ADMINISTRATORS, EXCEPT FARM','SALES WORKERS',         04021
              'CLERICAL AND KINDRED WORKERS','CRAFTSMEN AND KINDRED WORKERS',       04031
               'OPERATIVES, EXCEPT TRANSPORT','TRANSPORT EQUIPMENT OPERATIVES',     04041
            'LABORERS, EXCEPT FARM','FARMERS AND FARM MANAGERS','FARM LABORERS AND  04051
            FARM FOREMEN','SERVICE WORKERS, EXC. PRIVATE HOUSEHOLD',                04061
                                        'PRIVATE HOUSEHOLD WORKERS');               04071
                                                                                    04081
                      /* INDUSTRY=NAME OF INDUSTRY--FOR PRINTING */                 04091
                                                                                    04101
 148        DCL INDUSTRY(7) CHAR(97)                                                04111
                INIT('AGRICULTURE, FORESTRY, AND FISHERIES',                        04121
            'MINING AND CONSTRUCTION','MANUFACTURING, TRANSPORTATION, COMMUNICATION 04131
            S, AND OTHER PUBLIC UTILITIES','WHOLESALE AND RETAIL TRADE',            04141
            'FINANCE, INSURANCE, AND REAL ESTATE','BUSINESS, REPAIR, PERSONAL, ENTE 04151
            RTAINMENT AND RECREATIONAL, AND PROFESSIONAL AND RELATED SERVICES',     04161
            'PUBLIC ADMINISTRATION');                                               04171
                                                                                    04181
            /* VARIABLE  FOR PRINTING '_____'. */                                   04191
                                                                                    04201.
 149        DCL S2 FIXED(2);                                                        04211
                                                                                    04221
                        /* PARAMETER FOR PROC MATRIX */                             04231
                                                                                    04241
 150        DCL V(5,6) FIXED(6);                                                    04251
                                                                                    04261
            /*VARIABLES FOR CAL AND PRINTING PCT_IN COLUMN IN IN,OUT TABLES.*/      04271
                                                                                    04281
 151        DCL WAY CHAR(7),  (PC(4),PT) FIXED(3),  PTT FIXED(6) INIT(0);          04291
                                                                                    04301
                   /* VARIABLES FOR CALCULATING INDUSTRY FIGURES */                 04311
                                                                                    04321
 152        DCL INDC FIXED(6), INDPCT FIXED(3);                                     04331
                                                                                    04341
            /* USING IN-MATRIX FROM TABLE, MATRIX PRINTS IN-TABLE. */               04351
            /* USING A CROSS-SECTION OF OCOUT, MATRIX PRINTS OUT-TABLE. */          04361
            /* USING PC,PT (ABOVE), MATRIX PRINTS LAST COL IN IN,OUT TABLES. */     04371
                                                                                    04381
 153        MATRIX: PROC (M) ;                                                      04391
 154                 DCL M(*,*) FIXED(6);                                           04401
 155            PUT SKIP(2) EDIT(      'AGE','MALE','FEMALE','TOTAL','WHITE','NONWHI 04411
            TE','TOTAL')                                                            04421
            (COL(22),A(3),COL(34),A(4),COL(46),A(6),COL(58),A(5),                   04431
            COL(70),A(5),COL(82),A(8),COL(94),A(5));                                04441
 156        PUT SKIP(0) EDIT(WAY) (COL(103),A(7));                                  04451
 157           PUT SKIP(0) EDIT('___','____','______','_____','_____','________',   04461
                '_____')(COL(22),A(3),COL(34),A(4),COL(46),A(6),COL(58),A(6),       04471
                COL(70),A(5),COL(82),A(8),COL(94),A(5));                            04481
 158        PUT SKIP(0) EDIT('_______') (COL(103),A(7));                            04491
 159            PUT SKIP EDIT(    '14-24',M(1,1),M(1,2),M(1,3),M(1,4),M(1,5),M(1,6) 04501
                 )(           COL(22),A(5),COL(34),F(6),COL(46),F(6),COL(58),F(6),  04511
                COL(70),F(6),COL(82),F(6),COL(94),F(6)             );               04521
 160      PUT SKIP(0) EDIT(PC(1)) (COL(108),F(3));                             04531
 161         PUT SKIP EDIT(    '25-34',M(2,1),M(2,2),M(2,3),M(2,4),M(2,5),M(2,6)  04541
               )(              COL(22),A(5),COL(34),F(6),COL(46),F(6),COL(58),  04551
          F(6),COL(70),F(6),COL(82),F(6),COL(94),F(6)                  );        04561
 162      PUT SKIP(0) EDIT(PC(2)) (COL(108),F(3));                              04571
 163         PUT SKIP EDIT(    '35-64',M(3,1),M(3,2),M(3,3),M(3,4),M(3,5),M(3,6)  04581
               )(              COL(22),A(5),COL(34),F(6),COL(46),F(6),COL(58),  04591
          F(6),COL(70),F(6),COL(82),F(6),COL(94),F(6)                  );        04601
 164      PUT SKIP(0) EDIT(PC(3)) (COL(108),F(3));                              04611
 165         PUT SKIP EDIT(    '65-  ',M(4,1),M(4,2),M(4,3),M(4,4),M(4,5),M(4,6)  04621
               )(              COL(22),A(5),COL(34),F(6),COL(46),F(6),COL(58),  04631
          F(6),COL(70),F(6),COL(82),F(6),COL(94),F(6)                  );        04641
 166      PUT SKIP(0) EDIT(PC(4)) (COL(108),F(3));                              04651
 167               PUT SKIP EDIT(    'TOTAL',M(5,1),M(5,2),M(5,3),M(5,4),        04661
          M(5,5),M(5,6)                                                          04671
               )(              COL(22),A(5),COL(34),F(6),COL(46),F(6),COL(58),  04681
          F(6),COL(70),F(6),COL(82),F(6),COL(94),F(6)                  );        04691
 168      PUT SKIP(0) EDIT(PT   ) (COL(108),F(3));                               04701
 169      RETURN;                                                                04711
 170             END MATRIX;                                                     04721
                                                                                 04731
          /* AFTER PROCESSING  STATES ON  INFO, CAL AND PRINT INDUSTRY FIGURES.*/ 04741
                                                                                 04751
 171      ON ENDFILE(INFO) GOTO INDUST;                                          04761
                                                                                 04771
 173      PUT PAGE;                                                              04781
                                                                                 04791
 174      DO L=1 TO 51;                                                          04801
                                                                                 04811
               /* READ IN A STATE(ONE RECORD) FROM INFO. */                      04821
                                                                                 04831
 175      READ FILE (INFO) INTO (TABLE);                                         04841
                                                                                 04851
                /* FIND OUT WHICH STATE IT IS. */                                04861
                                                                                 04871
 176      I= Z(TABLE(1).STAAT);                                                  04881
                                                                                 04891
 177      S2=LENGTH(STATE(I));                                                   04901
                                                                                 04921
                     /* PRINT STATE MEANS. */                                    04931
                                                                                 04941
 178      PUT        EDIT('STATE: ',STATE(I))(A(7),COL(8),A(20));                04951
 179         PUT SKIP(0) EDIT('____________________')(COL(8),A(S2));             04961
 180                   DO J= 1 TO 12;                                            04971
                                                                                 04981
 181      S2=LENGTH(JOB(J));                                                     04991
                                                                                 05011
 182      PUT SKIP     EDIT('OCCUPATION: ',JOB(J))(A(12),COL(13),A(44));         05021
 183      PUT SKIP(0) EDIT('______________________________________________')     05031
          (COL(13),A(S2));                                                       05041
 184      PUT SKIP(2) EDIT('TOTAL INCLUDED: ',TABLE(  J).UCTAL) (A(16),F(6));    05051
 185      PUT SKIP     EDIT('PERCENT OCCUPATION EXCLUDED: ',TABLE(  J).PCTEXL)   05061
                          (A(29),F(3));                                          05071
 186      PUT SKIP   EDIT('TOTAL INCOME(1969): ',TABLE(  J).INCOME,'STATE/NATIONA 05081
          L: ',         TABLR(I,J).INCOME_R)(A(20),F(5),COL(51),A(16),F(6,2));   05091
 187      PUT SKIP     EDIT('HIGHEST GRADE ATTENDED: ',TABLE(  J).HRADE,         05101
           'STATE/NATIONAL: ',TABLR(I,J).HRADE_R)(A(24),F(2),COL(51),A(16),      05111
```

```
                  F(6,2));
188        PUT SKIP    EDIT('HOURS WORKED: ',TAPLE(  J).LRS,'STATE/NATIONAL: ',
                  TABLR(I,J).LRS_R)(A(14),F(2),COL(51),A(16),F(6,2));
189        PUT SKIP  EOIT('PERCENT BORN CUT OF STATE: ',TABLE(  J).PCT_BORN_OUT,
                          'STATE/NATICNAL: ',TAELR(I,J).PCT_R)(A(27),F(3),
                COL(51),A(16),F(6,2));
190        PUT SKIP    EDIT('INCOME FRCM PUBLIC ASSISTANCE: ',TABLE(  J).PUBASSIST
                  ,'STATE/NATIONAL: ',TABLP(I,J).PUBASSIST_R,'PERCENT REC.: ',
                  TABLE(  J).PUB_PCT,'STATE/NATICNAL: ',TABLR(I,J).PUB_PCT_P)
                  (A(31),F(6),COL(51),A(16),F(6,2),X(4),A(14),F(3),X(2),A(16),
                  F(6,2));
191        PUT SKIP    EDIT('RATIO OF INCOME TO POV. CUTOFF: ',TABLE(  J).POV_R,
                  'STATE/NATIONAL: ',TABLR(I,J).POV_RR)(A(32),F(6,2),COL(51),
                  A(16),F(6,2));

192        PUT SKIP;

                /*  PRINT HEADING  FOR TABLE. */

193        PUT SKIP EDIT('INMIGRATICN') (CCL(22),A(11));
194                 PUT SKIP(0) EDIT('___________')(COL(22),A(11));

                  /* INITIALIZE PARAMETER. */

195        V(*,*)=TABLE(J).IN(*,*);

                  /* CALCULATE PCT COLUMN CF TABLE. */

196        WAY='PCT  IN';
197        IF THENOCC(I,J)=0 THEN DO;
199        PC=0;  PT=0;  END;
202        ELSE DO;
203        PC(*)=(TABLE(J).PIN(*)/THENOCC(I,J))*100;
204        DO B=1 TO 4;
205        PTT=PTT + TABLE(J).PIN(B);
206        END;
207        PT=(PTT/THENOCC(I,J))*100;
208        END;

                    /* PRINT TABLE. */

209        CALL MATRIX (V);

           /* SKIP A SPACE AND RESET WORKING VARIABLE PTT. */

210        PUT SKIP;
211        PTT=0;

                /*  PRINT HEADING  FOR TABLE. */

212        PUT SKIP EDIT('OUTMIGRATION') (COL(22),A(12));
213        PUT SKIP(0) EDIT('____________')(CCL(22),A(12));

                  /* INITIALIZE PARAMETER. */

214        V(*,*)=OOOUT(I,J,*,*);
```

```
                        /* CALCULATE PCT COLUMN OF TABLE. */                     05691
                                                                                 05701
  215           WAY='PCT OUT';                                                   05711
  216           IF THENOCC(I,J)=0 THEN DO;                                       05721
  218           PC=0;  PT=0;  END;                                               05731
  221           ELSE DO;                                                         05741
  222           DO B=1 TO 4;                                                     05751
  223           PC(B)=( (ODOUT(I,J,B,1)+ODOUT(I,J,B,2))/THENOCC(I,J) )*100;      05761
  224           PTT= PTT + ODOUT(I,J,B,1) + ODOUT(I,J,B,2);                      05771
  225           END;                                                             05781
  226           PT=(PTT/THENOCC(I,J))*100;                                       05791
  227           END;                                                             05801
                                                                                 05811
                          /* PRINT TABLE. */                                     05821
                                                                                 05831
  228           CALL MATRIX (V);                                                 05841
                                                                                 05851
                            /* RESET WORKING VARIABLE PTT. */                    05861
                                                                                 05871
  229           PTT=0;                                                           05881
                                                                                 05891
                /* OUTPUT FOR TWO OCCUPATIONS  FITS ON A PAGE. */                05901
                                                                                 05911
  230           IF J=2 | J=4 | J=6 | J=8 | J=10 THEN PUT LINE(2);                05921
                                                                                 05931
  232           END;                                                             05941
                                                                                 05951
  233           PUT PAGE;                                                        05961
                                                                                 05971
  234           END;                                                             05981
                                                                                 05991
                            /* NOW DO INDUSTRY FIGURES.  */                      06001
                                                                                 06011
  235           INDUST:                                                          06021
                CLOSE FILE(INFO);                                                06031
  236           OPEN FILE(INFO) INPUT RECORD;                                    06041
                                                                                 06051
                        /* AFTER LAST STATE, GO TO END OF PRINT_OUT. */          06061
                                                                                 06071
  237           ON ENDFILE(INFO) GOTO LAST;                                      06081
                                                                                 06091
  239           M=1;                                                             06101
                                                                                 06111
  240           DO L=1 TO 51;                                                    06121
                                                                                 06131
                /*  READ RECORDS FROM INFO TO KNOW WHICH STATES WE ARE PROCESSING. */  06141
                                                                                 06151
  241           READ FILE(INFO) INTO (TABLE);                                    06161
                                                                                 6162
                            /* FIND OUT WHICH STATE IT IS. */                    6163
                                                                                 06171
  242           I= Z(TABLE(1).STAAT);                                            06181
                                                                                 06191
                                 /* PRINT HEADING */                             6192
                                                                                 6193
  243           PUT EDIT('STATE: ',STATE(I)) (COL(1),A(7),COL(8),A(20));         06201
  244               PUT SKIP(0) EDIT('____________________')(COL(8),A(20));      06211
```

```
                                                                                    6212
                                         /* CALCULATE */                            6213
                                                                                    6214
     245             DO J=1 TO 7;                                                  06221
     246             INDC=IND70(I,J)-IND65(I,J);                                   06231
     247             IF IND65(I,J)=0 THEN INDPCT=0; ELSE                           06241
     249             INDPCT=( INDC/IND65(I,J) )*100;                               06251
                                                                                    6252
                                         /* PRINT RESULTS */                        6253
                                                                                    6254
     250             PUT SKIP(2) EDIT('INDUSTRY: ',INDUSTRY(J)) (A(10),COL(11),A(97));   06261
     251             PUT SKIP EDIT('CHANGE IN EMPLOYMENT 1965-1970: ',INDC) (A(32),F(7));  06271
     252             PUT SKIP EDIT('PERCENT CHANGE IN EMPLOYMENT 1965-1970: ',INDPCT)    06281
                     (A(40),F(3));                                                 06291
                                                                                   06301
     253             END;                                                          06311
                                                                                   06321
                               /* ROOM FOR TWO STATES ON EACH PAGE. */             06331
                                                                                   06341
     254             IF M=0 THEN DO;                                               06351
     256             PUT PAGE;  M=1;     GOTO BACK;                                06361
     259             END;                                                          06371
                                                                                   06381
     260             IF M=1 THEN DO;                                               06391
     262             PUT SKIP(2);  M=0;                                            06401
     264             END;                                                          06411
                                                                                   06421
     265             BACK:  END;                                                   06431
                                                                                   06441
     266             LAST:                                                         06451
                                                                                   06461
                     RETURN;                                                       06471
     267                           END PRINT_OUT;                                  06481
                                                                                   06491
                                         /* MAIN PROG OF PROC NAT_TRANS BEGINS HERE. */   06501
                                                                                   06511
                               /* AFTER LAST STATE, CALL NAT_TRANS. */             06521
                                                                                   06531
     268             ON ENDFILE(INFO) GOTO OVER;                                   06541
                                                                                   06551
                     /* FOR EACH STATE ON INFO, CAL STATE/NAT RATIOS AND SUM OODUT COLS. */  06561
                       /* IF STATEMENTS ARE PUT IN TO AVOID ZERODIVIDE. */         06571
                                                                                   06581
     270                          DO A=1 TO 51;                                    06591
                                                                                   06601
                     /* READ IN TABLE FROM INFO */                                 06611
                                                                                   06621
     271             READ FILE(INFO) INTO (TABLE);                                 06631
                                                                                   06641
                     /* FIND OUT WHICH STATE IT IS */                              06651
                                                                                   06661
     272             I=Z(TABLE(1).STAAT);                                          06671
                                                                                   06681
     273                         DO J=1 TO 12;                                     06691
                                                                                   06701
                     /*ROWS-OUT-TABLE(SUM OF ROWS1-4) MUST =0 BEFORE SUMMING AGAIN. */  06711
                                                                                   06721
```

```
274                     OCOUT(I,J,5,*)=0;                                            06731
                                                                                     06741
275          IF NTOT(J)=0 THEN GOTO SKIP;                                            06751
                                                                                     06761
                                                                                     06771
             /* COL6=COL5 + COL4 IN OUT-TABLE. */                                    06781
                                                                                     06791
277          OCOUT(I,J,*,6)=OCOUT(I,J,*,5) + OCOUT(I,J,*,4);                         06801
                                                                                     06811
             /* COL3=COL2 + COL1 IN OUT-TABLE. */                                    06821
                                                                                     06831
278          OCOUT(I,J,*,3)=OCOUT(I,J,*,2) + OCOUT(I,J,*,1);                         06841
                                                                                     06851
                                                                                     06861
             /* ROW5= SUM OF FIRST 4 ROWS OF OUT-TABLE. */                           06871
                                                                                     06881
279                 DO L=1 TO 4;                                                     06891
280          OCOUT(I,J,5,*)=OCOUT(I,J,L,*) + OCOUT(I,J,5,*);                         06901
281                 END;                                                             06911
                                                                                     06921
                          /* CALCULATE RATIOS. */                                    06931
                                                                                     06941
282          IF NINC(J)=0 THEN TABLR(I,J).INCOME_R=0;                                06951
284          ELSE                                                                    06961
284          TABLR(I,J).INCOME_R=TABLE(  J).INCOME/(NINC(J)/NTOT(J));                06971
285          IF NTOTW(J)=0 THEN TABLR(I,J).LRS_R=0;                                  06981
287          ELSE                                                                    06991
287          TABLR(I,J).LRS_R    =TABLE(  J).LRS    /(NHRS(J)/NTOTW(J));             07001
288          IF NGRADE(J)=0 THEN TABLR(I,J).HRADE_R=0;                               07011
290          ELSE                                                                    07021
290          TABLR(I,J).HRADE_R= TABLE(J).HRADE/(NGRADE(J)/NTOT(J));                 07031
291          IF NBIRTH(J)=0 THEN TABLR(I,J).PCT_R=0;                                 07041
293          ELSE                                                                    07051
293          TABLR(I,J).PCT_R    =TABLE(  J).PCT_BORN_OUT/((NBIRTH(J)/NTOT(J))*100);  07061
294          IF NPUBCTR(J)=0 THEN DO;                                                07071
296          TABLR(I,J).PUBASSIST_R=0;                                               07081
297          TABLR(I,J).PUB_PCT_R=0;                                                 07091
298          END;                                                                    07101
299          ELSE DO;                                                                07111
300          TABLR(I,J).PUBASSIST_R=TABLE(  J).PUBASSIST/(NPUB(J)/NPUBCTR(J));       07121
301          TABLR(I,J).PUB_PCT_R=TABLE(  J).PUB_PCT/((NPUBCTR(J)/NTOT(J))*100);     07131
302          END;                                                                    07141
303          IF NPOV(J)=0 THEN TABLR(I,J).POV_RR=0;                                  07151
305          ELSE                                                                    07161
305          TABLR(I,J).POV_RR=TABLE(  J).POV_R/(NPOV(J)/NTOT(J));                   07171
                                                                                     07181
306          SKIP:     END;                                                          07191
                                                                                     07201
307                 END;                                                             07211
                                                                                     07221
308          OVER:                                                                   07231
                                                                                     07241
             CLOSE FILE(INFO);                                                       07251
                                                                                     07261
                           /* SAVE INFORMATION NEEDED FOR NEXT RUN. */               07271
                                                                                     07281
309          OPEN FILE(TEMPNEW) OUTPUT RECORD;                                       07291
```

```
310              CALL TRANSFER_OUT;                                                  07301
311              CALL NAT_TRANS;                                                     07311
312              CLOSE FILE(TEMPNEW);                                                07321
                                                                                     07331
                            /* PRINT */                                              07341
                                                                                     07351
313              OPEN FILE(INFO) INPUT RECORD;                                       07361
314              CALL PRINT_OUT;                                                     07371
                                                                                     07381
315              RETURN;                                                             07391
316              END NAT_CAL;                                                        07401
                                                                                     07411
                                                                                     07421
                                   /* MAIN PROGRAM BEGINS HERE. */                   07431
                                                                                     07441
                                                                                     07451
                 /* THE MAIN PROG READS DATA FROM UNIT INTO HOUSE(HOUSEHOLD REC) AND */ 07461
                 /* PERSON(PERSON REC) AND EXTRACTS NUMBERS TO UPDATE  VARIOUS   */    07471
                 /* COUNTERS. FOR EACH CHARACTERISTIC,E.G., INCOME, THERE IS A  */     07481
                 /* CURRENT STATE COUNTER (INC) AND A CORR. RUNNING NATIONAL*/         07491
                 /* COUNTER(NINC). PERSONS WHO WERE IN A DIFFERENT STATE 5 YRS AGO */  07501
                 /* ARE COUNTED IN  AN IN TABLE AND AN OUT TABLE BY AGE (ROW) AND */   07511
                 /* COLOR AND SEX (COLS).  THE CURRENT STATE IS DETERMINED BY  */      07521
                 /* HOUSE.NOWSTATE SET = NOWSTATE. NUMBER OF PERSON REC THAT FOLLOW */ 07531
                 /* A HOUSE REC IS  DETERMINED BY HOUSE.NUM SET = NUM.   AFTER A REC */ 07541
                 /* IS READ IN A CHECK IS MADE TO VERIFY ITS TYPE. THE CHECK ONLY */   07551
                 /* DISTINGUISHES BETWEEN HOUSE TYPE & PERSON TYPE REC AND VERIFIES */ 07561
                 /*THAT THEY ARE 5 PCT-STATE DATA. OTHER INPUT ERRORS(INCORRECT REC */ 07571
                 /* LENGTH,ETC.) WILL TERMINATE PROGRAM. SEE MAIN PROGRAM FOR LOOP */  07581
                 /* TO HANDLE HOUSE REC-PERSON REC MIXUP.  EACH PERSON REC */          07601
                 /* IS  SUBJECTED TO TWO TESTS BEFORE BEING USED 1. THOSE NILF ARE */  07611
                 /* BYPASSED. 2. THOSE NOT REPORTING WHEREABOUTS 5 YRS AGO ARE */      07621
                 /* COUNTED (BCTR) BUT NOT OTHERWISE RECORDED. EACH TIME A HOUSE REC */ 07631
                 /* IS READ IN WITH NOWSTATE ¬=NOWSTATE PROC STATE_CAL IS CALLED. */   07641
                 /* AT END OF STATE_CAL, NOWSTATE IS UPDATED,AND CURRENT STATE  */     07651
                 /* COUNTERS ARE SET =0.  AT END OF DATA, CONTROL GOES TO  SAVE WHERE */ 07661
                 /* STATE_CAL IS CALLED FOR THE LAST TIME. THEN FILE(UNIT) IS CLOSED. */ 07671
                 /*1ST RUN-CERTAIN CTRS SET=0-OTHER RUNS ARE WRITTEN BY TRANSFER_IN. */ 07691
                 /*AT END OF RUN,TEMPNEW LOOKS LIKE: 51 REC OF 'PCOUT,1 REC OF */      07691
                 /* 'STUFF',51 REC OF 'IND'(THESE 3 WRITTEN BY TRANSFER_OUT),AND */    07701
                 /* 51 REC OF 'TABLR' DONE BY NAT_TRANS. */                            07711
                                                                                     07721
                                /* INITIALIZATION */                                 07731
                                                                                     07741
317              TABLE=0;                                                            07751
                                                                                     07761
                 /* FIRST RUN ONLY-FOLLOWING CARDS USED FOR ADDITIONAL INITIALIZATION.*/ 07771
                 /* OOOUT=0; NTOT=0; NTOTH=0; NINC=0; NGRADE=0; NBIRTH=0; NHRS=0; */  07781
                 /* NPUB=0; NPUBCTR=0; NPOV=0; IND70=0; IND65=0; THENOCC=0; */         07791
                                                                                     07801
                 /* ALL RUNS AFTER 1ST-TRANSFER_IN CALLED AND DATA CHECK MADE. */      07811
                                                                                     07821
318              OPEN FILE(TEMPOLD) INPUT RECORD;                                    07831
319              CALL TRANSFER_IN;                                                   07841
320              CLOSE FILE(TEMPOLD);                                                07851
                                                                                     07861
                 /* DATA CHECK-SAMPLE OF DATA READ IN FROM TEMPOLD. */                 07871
```

```
 321        PUT SKIP DATA(NTOT(1),NTOTW(2),NINC(3),NGRADE(4),NBIRTH(5),
            NHRS(6),NPUB(7),NPUBCTR(8),NPCV(9));

 322        PUT SKIP DATA(OCOUT(14,1,1,1),OCOUT(14,1,1,2));
 323        PUT SKIP DATA(OCOUT(14,1,2,1),OCOUT(14,1,2,2));
 324        PUT SKIP DATA(OCOUT(14,1,3,1),OCOUT(14,1,3,2));
 325        PUT SKIP DATA(OCOUT(14,1,4,1),OCOUT(14,1,4,2));

 326        PUT SKIP DATA(OCOUT(22,2,3,4));

 327        PUT SKIP DATA(IND70(14,6),IND65(14,6),THENOCC(14,1));

 328        OPEN FILE(UNIT) INPUT RECORD,FILE(INFO) OUTPUT RECORD;
 329        ON ERROR PUT DATA(REC);
 331        ON FINISH PUT DATA(REC);

            /* AT END OF DATA, CALL STATE_CAL FOR LAST TIME. */

 333             ON ENDFILE(UNIT) GOTO SAVE;

            /*ALWAYS GOTO CHECK TO READ IN HOUSE REC. 1ST REC IS HOUSE REC. */

 335        CHECK:


            /* REC= NUMBER OF REC TO BE READ. */

            REC = REC + 1;

 336               READ FILE(UNIT) INTO (HOUSE);

            /* RECORD CHECK: STATE-5 PCT,HOUSE TYPE ,NOT PERSON TYPE. */

 337               IF¬(HOUSE.SAMPLE='4' & HOUSE.TYPE='2' ) THEN DO;

            /* BH COUNTS NUMBER TIMES WE ENTER THIS LOOP. */

 339        BH= BH + 1;

            /* PRINT A MESSAGE. */

 340        PUT SKIP DATA(BH,REC);
 341                          PUT       DATA(NUM,HOUSE.SAMPLE,HOUSE.TYPE);
 342                                        PUT LIST('NOT A HOUSE REC');

            /* EACH BAD REC IS INCLUDED IN BCTR(EACH OCC). */

 343        BCTR= BCTR + 1;

            /* TRY AGAIN FOR HOUSE RECORD. */

 344        AGAIN:  REC= REC + 1;

 345               READ FILE(UNIT) INTO(HOUSE);

 346               IF¬(HOUSE.SAMPLE='4' & HOUSE.TYPE='2' ) THEN DO;
```

```
                /* P COUNTS HOW MANY REC WE SKIP UNTIL REACH NEXT GOOD HOUSE REC. */

   348          P= P + 1;

                /* BCTR GETS THESE TOO. */

   349          BCTR= BCTR + 1;
   350          GOTO AGAIN;
   351          END;

   352          IF HOUSE.SAMPLE='4' & HOUSE.TYPE='2' THEN  DO;

                /* HAVE GOOD HOUSE REC-RESET P,NUM AND PRINT MESSAGE. */

   354          PUT DATA(P);
   355           P=0;
   356          NUM=0;
   357          END;

   358          END;

                /* IF THIS IS FIRST REC READ, SET NOWSTATE. */

   359          IF NOWSTATE='00' THEN NOWSTATE=HOUSE.NEWSTATE;

                /* NUM=NUMBER OF REC TO BE READ INTO PERSON(MEMBERS OF THIS HOUSE-*/
                /*HOLD). NUM MUST =0 BEFORE REC IS READ INTO HOUSE. NUM¬=0 IMPLIES */
                /*HOUSE.NUM NOT ACCURATE OR REC MISSING-UP CTRS,PRINT MES,GOTO CHECK.*/
                /* TO FIND NEXT GOOD HOUSE RECORD. */

   361                IF NUM¬= 0 THEN DO;

   363                PUT LIST('NUM NOT EQUAL TO 0');
   364          BCTR=BCTR+1;  PUT DATA(NUM,HOUSE.NUM,REC);
   366          PUT LIST('READ UNIT INTO HOUSE UNTIL WE GET NEXT HOUSE RECORD');
   367          GOTO CHECK;

   368          END;

                /* IF LAST HOUSE REC IS IN DIFF STATE--DO STATE CALCULATIONS. */

   369               IF NOWSTATE¬=HOUSE.NOWSTATE THEN CALL STATE_CAL;

                /* RESET NUM FOR THIS HOUSEHOLD. */

   371                NUM=HOUSE.NUM;

                /* IF HOUSE VACANT, READ IN NEXT HOUSE RECORD. */

   372          IF NUM = 0 THEN GOTO CHECK;

                /*OTHERWISE READ IN PERSON REC-ALWAYS GOTO ANOTHER TO READ PERSON REC*/

   374          ANOTHER:

                REC = REC + 1;
```

```
                                                                                  09021
 375              READ FILE(UNIT) INTO (PERSON);                                  09031
                                                                                  09041
                                                                                  09051
         /* IF THIS IS NOT PERSON TYPE REC(PROB HOUSE INSTEAD) THEN WE UP */      09061
         /*CTRS.PRINT MES AND SEARCH FOR NEXT GOOD HOUSE REC BY GOING TO CHECK*/  09071
                                                                                  09081
 376        IF PERSON.TYPE¬='4' THEN DO;                                          09091
                                                                                  09101
 378     BCTR=BCTR + 1;                                                           09111
 379     PUT SKIP DATA(NUM,HOUSE.NUM,REC,PERSON.TYPE);                            09121
 380                                 PUT LIST('NOT A PERSON REC');                09131
 381     PUT LIST('READ UNIT INTO HOUSE  UNTIL WE GET NEXT HOUSE RECORD');        09141
 382     GOTO CHECK;                                                              09151
                                                                                  09161
 383                                 END;                                         09171
                                                                                  09181
         /*SKIP PERSON NILE BY DEC NUM & GOING TO GO_ON */                        09191
                                                                                  09201
 384        IF ¬(PERSON.PCC > '000' & PERSON.PCC < '990' & PERSON.EMP > '0'       09211
 385        & PERSON.EMP < '4' & PERSON.POVCUT¬= '8') THEN DO;                    09221
                                                                                  09231
 386                                 NUM=NUM-1; GOTO GO_ON; END;                  09241
                                                                                  09251
         /* FIND OUT 1970 OCC=OCC. */                                             09261
                                                                                  09271
 389        TOCC=PERSON.PCC;                                                      09281
 390        IF TOCC < 201 THEN OCC=1;  IF TOCC > 200 & TOCC < 260 THEN OCC=2;     09291
 394        IF TOCC > 259 & TOCC < 301 THEN OCC=3;  IF TOCC > 300 & TOCC < 401    09301
 397                                                THEN OCC=4;                   09311
 398        IF TOCC > 400 & TOCC < 601 THEN OCC=5;                                09321
 400        IF TOCC > 600 & TOCC < 701 THEN OCC=6;                                09331
 402        IF TOCC > 700 & TOCC < 740 THEN OCC=7;                                09341
 404        IF TOCC > 739 & TOCC < 801 THEN OCC=8;                                09351
 406        IF TOCC > 800 & TOCC < 821 THEN OCC=9;                                09361
 408        IF TOCC > 820 & TOCC < 901 THEN OCC=10;                               09371
 410        IF TOCC > 900 & TOCC < 980 THEN OCC=11;                               09381
 412        IF TOCC > 979 THEN OCC=12;                                            09391
                                                                                  09401
         /* IF RESIDENCE IN '65 NOT SPEC, UP BCTR THEN DEC NUM & GO_ON. */        09411
                                                                                  09421
 414     IF PERSON.THENSTATE= '99' THEN DO;                                       09431
 416                               BCTR(OCC)=BCTR(OCC)+1;                         09441
 417                               NUM=NUM-1;                                     09451
 418                               GOTO GO_ON;                                    09461
 419                          END;                                                09471
                                                                                  09481
         /* IF PERSON PASSES ABOVE TESTS, THEN PROCESSING BEGINS HERE. */         09482
                                                                                  09491
         /* UP TOTAL CTRS IN OCC */                                               09501
                                                                                  09511
 420        TOTAL(OCC)=TOTAL(OCC)+1;  NTOT(OCC)=NTOT(OCC)+1;                      09521
                                                                                  09531
         /* IF OCC-65 NOT SPEC,THEN OCC5 WILL STAY=0. */                          09541
                                                                                  09551
 422     OCC5=0;                                                                  09561
                                                                                  09571
```

```
                /* IF OCC'65 SPEC THEN CALCULATE '65 OCC=OCC5. */                      09581
                                                                                       09591
   423          IF PERSON.PCC5 > '000' & PERSON.PCC5 < '990' THEN DO;                  09601
                                                                                       09611
   425          TOCC=PERSON.PCC5;                                                      09621
   426          IF TOCC < 201 THEN OCC5=1; IF TOCC > 200 & TOCC < 260 THEN OCC5=2;     09631
   430          IF TOCC > 259 & TOCC < 301 THEN OCC5= 3;                               09641
   432          IF TOCC > 300 & TOCC < 401 THEN OCC5=4;                                09651
   434          IF TOCC > 400 & TOCC < 601 THEN OCC5=5;                                09661
   436          IF TOCC > 600 & TOCC < 701 THEN OCC5=6;                                09671
   438          IF TOCC > 700 & TOCC < 740 THEN OCC5=7;                                09681
   440          IF TOCC > 739 & TOCC < 801 THEN OCC5=8;                                09691
   442          IF TOCC > 800 & TOCC < 821 THEN OCC5=9;                                09701
   444          IF TOCC > 820 & TOCC < 901 THEN OCC5=10;                               09711
   446          IF TOCC > 900 & TOCC < 980 THEN OCC5=11;                               09721
   448          IF TOCC > 979 THEN OCC5=12;                                            09731
                                                                                       09741
   450          END;                                                                   09751
                                                                                       09761
                /* IF PERSON INCOME¬=0 THEN TRANSLATE CODE TO MEAN VALUE;INC CTRS. */  09771
                                                                                       09781
   451          IF PERSON.INCOME¬='999' THEN  DO;                                      09791
                                                                                       09801
   453                                   PINC1=PERSON.INCOME;                          09811
   454                                  IF PINC1 >= 0 THEN PINC=PINC1*100 + 50;        09821
   456                                  ELSE PINC=PINC1*100 - 50;                      09831
                                                                                       09841
   457                                   INC(OCC)= INC(OCC)+PINC;                      09851
   458                                   NINC(OCC)=NINC(OCC)+PINC;                     09861
                                                                                       09871
   459                                   END;                                          09881
                                                                                       09891
                /* ADD TO CTRS HIGHEST GRADE ATTAINED. */                              09901
                                                                                       09911
   460              GRADE(OCC)=GRADE(OCC)+PERSON.HRADE;                                09921
   461              NGRADE(OCC)=NGRADE(OCC)+PERSON.HRADE;                              09931
                                                                                       09941
                /*IF 'AT WORK', CALCULATE HRS WORKED(MEAN VALUE) AND UP CTRS. */       09951
                                                                                       09961
   462          IF PERSON.EMP='1' THEN  DO;                                            09971
                                                                                       09981
   464                             H=PERSON.LRS;                                       09991
                                                                                       10001
   465                             IF H=0 THEN H=8;  IF H=1 THEN H=22;                 10011
   469                             IF H=2  THEN H=32;  IF H=3 THEN H=37;               10021
   473                             IF H=4 THEN H=40;  IF H=5 THEN H=44;                10031
   477                             IF H=6 THEN H=54;  IF H=7 THEN H=60;                10041
                                                                                       10051
   481                             TOTW(OCC)=TOTW(OCC)+1;  NTOTW(OCC)=NTOTW(OCC)+1;    10061
   483                             HRS(OCC)=HRS(OCC)+H;  NHRS(OCC)=NHRS(OCC)+H;        10071
                                                                                       10081
   485                             END;                                                10091
                                                                                       10101
                /* IF BORN OUT OF STATE, UP CTRS. */                                   10111
                                                                                       10121
   486          IF ¬( (PERSON.PLACE= '1' & PERSON.BIRTH=NEWSTATE) | (PERSON.BIRTH=     10131
   487                                   '99') ) THEN DO;                              10141
```

```
 488                                BIRTH(OCC)=BIRTH(OCC)+1;
 489                                NBIRTH(OCC)=NBIRTH(OCC)+1;

 490                                END;

                /* IF RECEIVED PUBLIC ASSIST.,CAL MEAN VALUE, UP CTRS. */

 491            IF PERSON.PUBASSIST¬='999' THEN DO;

 493                              PAS1=PERSON.PUBASSIST;
 494                                 PAS=PAS1*100 + 50;

 495                                 PUBCTR(OCC)=PUBCTR(OCC)+1;
 496                                 NPUBCTR(OCC)=NPUBCTR(OCC)+1;
 497                                 PUB(OCC)=PUB(OCC)+PAS;
 498                                 NPUB(OCC)=NPUB(OCC)+PAS;

 499                                 END;

                /* CALCULATE MEAN RATIO: INC/POV. LEVEL,UP CTRS. */

 500               PV=PERSON.POVCUT;

 501               IF PV=0 THEN PV=.25;  IF PV=1 THEN PV=.62;
 505               IF PV=2 THEN PV=.87;  IF PV=3 THEN PV=1.12;
 509               IF PV=4 THEN PV=1.37;  IF PV=5 THEN PV=1.75;
 513               IF PV=6 THEN PV=2.50;  IF PV=7 THEN PV=3.00;

 517               POV(OCC)=POV(OCC)+PV;  NPOV(OCC)=NPOV(OCC)+PV;

                /* K1=STATE OF RES 1970(INTEGER-ALPHABETICAL ORDER).K2 REMAINS 0 IF */
                /* STATE OF RES 1965 NOT SPEC.  */

 519                  K1=Z(NOWSTATE);     K2=0;

                /* IF STATE OF RES '65 SPEC,THEN CALCULATE K2=INTEGER(ALPHABETICAL */
                /* ORDER OF STATE OF RES IN '65.). */

 521            IF (PERSON.THENSTATE > '00' & PERSON.THENSTATE < '57') THEN
 522                                          K2= Z(THENSTATE);

                /* IF PERSON SPEC BOTH OCC & STATE FOR '65 THEN UP CTR. */

 523            IF OCC5¬=0 & K2¬=0 THEN
 524                         THENOCC(K2,OCC5)=THENOCC(K2,OCC5) + 1;

                /*IF PERSON IS IN MIGRANT THEN UPDATE IN-MATRIX. */

 525            IF PERSON.THENSTATE¬=NOWSTATE THEN DO;

                                /* CALCULATE ROW. */

 527                           AGE=PERSON.AGE;

 528               IF AGE < 25 THEN AGEROW=1;  IF AGE > 24 & AGE < 35 THEN AGEROW=2;
 532               IF AGE > 34 & AGE < 65 THEN AGEROW=3;  IF AGE > 64 THEN AGEROW=4;
```

```
                                                                              10721
                          /* CALCULATE CCLUMN. */                             10731
                                                                              10741
  536                   IF PERSON.SEX='0' THEN SEXCOL=1;  ELSE SEXCOL=2;       10751
  539                   IF PERSON.COLOR='0' THEN COLORCOL=4;  ELSE COLORCOL=5; 10761
                                                                              10771
            /* PIN=TOTAL IN AN AGE CAT. USED FOR PCT COL. UPDATE PIN,IN-MATRIX. */ 10781
                                                                              10791
  542       TABLE(OCC).PIN(AGEROW)=TABLE(OCC).PIN(AGEROW) + 1;                10801
                                                                              10811
  543       TABLE(   OCC).IN(AGERCW,SEXCCL)=TABLE(   OCC).IN(AGEROW,SEXCOL)+1; 10821
  544       TABLE(   OCC).IN(AGEPOW,COLORCCL)=TABLE(   OCC).IN(AGEROW,COLORCOL)+1; 10831
                                                                              10841
  545                                END;                                     10851
                                                                              10861
            /* IF IN ANOTHER STATE IN '65,UPDATE OUT-MATRIX. */               10871
                                                                              10881
  546       IF K2¬=0 & PERSCN.THENSTATE¬=NCWSTATE THEN DO;                     10891
                                                                              10901
  548       COOUT(K2,OCC,AGEROW,SEXCOL)=COOUT(K2,CCC,AGERCW,SEXCOL) + 1;       10911
  549       OCOUT(K2,OCC,AGERCW,COLORCOL)=COCUT(K2,OCC,AGEROW,COLORCOL) + 1;   10921
                                                                              10931
  550                                END;                                     10941
                                                                              10951
            /*TRANSLATE CURRENT INDUSTRY FRCM CODE TO CAT. NO. AND UP CTR. */  10961
                                                                              10971
  551       ID1=PERSON.CURIND;                                                10981
                                                                              10991
  552       IF 016 < ID1 & ID1 < 030 THEN ID=1;                               11001
  554       IF 046 < ID1 & ID1 < 079 THEN ID=2;                               11011
  556       IF 106 < ID1 & ID1 < 500 THEN ID=3;                               11021
  558       IF 506 < ID1 & ID1 < 720 THEN ID=4;                               11031
  560       IF 725 < ID1 & ID1 < 818 THEN ID=5;                               11041
  562       IF 827 < ID1 & ID1 < 900 THEN ID=6;                               11051
  564       IF 906 < ID1 & ID1 < 948 THEN ID=7;                               11061
                                                                              11071
  566       IND70(K1,ID)=IND70(K1,ID) + 1;                                    11081
                                                                              11091
  567       ID1=PERSCN.IND5;                                                  11101
                                                                              11111
            /*IF IND '65 & STATE '65 SPEC, TRANSLATE CODE TO CAT. # AND UP CTR.*/ 11121
                                                                              11131
  568       IF ID1¬=0 & K2¬=0 THEN DO;                                        11141
  570       IF 016 < ID1 & ID1 < 030 THEN ID=1;                               11151
  572       IF 046 < ID1 & ID1 < 079 THEN ID=2;                               11161
  574       IF 106 < ID1 & ID1 < 500 THEN ID=3;                               11171
  576       IF 506 < ID1 & ID1 < 720 THEN ID=4;                               11181
  578       IF 726 < ID1 & ID1 < 818 THEN ID=5;                               11191
  580       IF 827 < ID1 & ID1 < 900 THEN ID=6;                               11201
  582       IF 906 < ID1 & ID1 < 948 THEN ID=7;                               11211
                                                                              11221
  584       IND65(K2,ID)=IND65(K2,ID) + 1;                                    11231
                                                                              11241
  585                         END;                                            11251
                                                                              11261
            /* DECREASE NUM SINCE A PERSCN HAS BEEN PROCESSED. */             11271
                                                                              11281
```

```
586            NUM=NUM-1;

         /* GO_ON TELLS US IF NEXT REC SHOULD BE READ INTO HOUSE OR PERSON.. */

587      GO_ON: IF NUM > 0 THEN GOTO ANOTHER;
589                 ELSE GOTO CHECK;

         /* AT END OF DATA, CALL STATE_CAL FOR LAST STATE. */

590      SAVE:
         CALL STATE_CAL;
591      CLOSE FILE(UNIT);
592      CLOSE FILE(INFO);

         /* DATA CHECK-SAMPLE OF DATA WRITTEN ON TEMPNEW. */

593      PUT SKIP DATA(NTOT(1),NTOTW(2),NINC(3),NGRADE(4),NBIRTH(5),
         NHRS(6),NPUB(7),NPUBCTR(8),NPCV(9));

594      PUT SKIP DATA(COOUT(14,1,1,1),COOUT(14,1,1,2));
595      PUT SKIP DATA(COOUT(14,1,2,1),COOUT(14,1,2,2));
596      PUT SKIP DATA(COOUT(14,1,3,1),COOUT(14,1,3,2));
597      PUT SKIP DATA(COOUT(14,1,4,1),COOUT(14,1,4,2));

598      PUT SKIP DATA(COOUT(22,2,3,4));

599      PUT SKIP DATA(IND70(14,6),IND65(14,6),THENOCC(14,1));

             /* DO NATIONAL CALCULATIONS,SAVE RESULTS, AND PRINT. */
         /* IN ORDER TO MONITOR EACH RUN,NAT_CAL IS CALLED IN EACH RUN. */

600      OPEN FILE (INFO) INPUT RECORD;
601      CALL NAT_CAL;
602      CLOSE FILE(INFO);

603      RETURN;
604      END START;
```

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VITA

Morris Michael Kleiner was born in Landsburg, Germany, on July 28, 1948. He graduated from Bradley University with a Bachelor of Science in Economics in 1971. He received a Master of Arts degree in Labor and Industrial Relations, University of Illinois at Urbana-Champaign in October 1972. The writer has authored or co-authored publications in manpower and regional planning, applied econometrics, and labor relations. This thesis was undertaken while the author was a doctoral candidate in economics through the Center for Advanced Computation, University of Illinois.

The author has served honorably with the United States Army, and his other positions have included examiner for the National Labor Relations Board, consultant to the Office of the Superintendent of Public Instruction, State of Illinois, and advisor to various federal agencies.

The writer is now an Assistant Professor in the School of Business, economics, the University of Kansas at Lawrence, Kansas.

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